# SUPPLYING SMALL SOLAR PHOTOVOLTAIC SYSTEMS TO HANOI, VIETNAM

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ABSTRACT

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The thesis aims at analyzing Hanoi solar PV market in order to clarify the market segments and then proposes a business opportunity to supply small solar PV systems.

The study used the qualitative and quantitative methods to collect data. The data was collected from internet surveys for two focus groups - SMEs and households. Data was also collected through observing the market, interviewing stakeholders and meeting with some potential customers. Another set of data was gathered from unpublished reports of some related organizations, such as EVN, MOIT, etc.

Hanoi is really open market for small solar home electric systems. The economic growth in the area is one of the highest in the world. It leads to the demand for energy in Vietnam in general, and in Hanoi in particular it is high and growing significantly. After the field research in summer 2011, the author realized that a solar home electric system is a good alternative solution for electricity shortage in Hanoi, and supplying small solar PV systems is a feasible business opportunity in the market. The suitable segments for the products are high income households and SMEs. The foreign investors should notice that household business is really common in Hanoi. They mostly use private houses as business premises and living place.

The suitable product for the market is Grid-Intertied Solar-Electric System with Battery Backup, which has capacity range from 1- 2 kWp for households and 2 - 3kWp for SMEs. The price these customer segments are willing to pay is different with each group.

Each case company has its own entry mode strategy and business model, depending on its key resources and its product service systems. However, in the study, the author also suggested business model Canvas for three case companies and suitable entry modes for these companies.

Key words: solar energy, small solar PVsystem, solar home electric systems, renewable energy, Hanoi, Vietnam, business model, high-income households, SMEs.

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**ABBREVIATIONS**

| | |
|---|---|
| ADB | Asian Development Bank |
| ASEAN | Association of Southern East Asian Nations |
| BOT | Build - Operate - Transfer |
| CDM | Clean Development Mechanism |
| EEI | Energy Efficiency Initiative |
| EUR | Euro (European Monetary Unit) |
| EVN | Vietnam Electricity |
| FDI | Foreign Direct Investment |
| HUT | Hanoi University of Technology |
| HAPI | Hanoi Planning and Investment |
| IMF | International Monetary Fund |
| IPPs | Independent Power Providers |
| kV | Kilovolt |
| kWp | Kilowatt-Peak |
| kWh | Kilowatt Hour |
| MOF | Ministry of Finance |
| MOIT | Ministry of Industry and Trade |
| MOLISA | Ministry of Labor Invalids and Social Affairs |
| MP | Master Plan |
| MPI | Ministry of Planning and Investment |
| MW | Megawatt |
| MWp | Megawatt peak |
| NGO | Non-governmental Organization |
| PCI | Provincial competitiveness index |
| PV | Photovoltaic |
| PR | Public relations |
| RE | Renewable Energy |
| SEA | Strategic Environmental Assessment |
| SMEs | Small and Medium Enterprises |
| USD | United States Dollar (currency of the USA) |
| UPS | Uninterruptible Power Supply |
| VND | Vietnam Dong (currency of Vietnam) |
| VUSTA | Vietnam Union of Science and Technology Associations |
| WB | World Bank |
| Wp | Watt-Peak |
| WTO | World Trade Organization |

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# 1 INTRODUCTION

This study will provide information about the Vietnamese solar PV market in general and Hanoi in particular and recommend business opportunity for foreign companies to supply small PV systems to Hanoi. The introduction part of the thesis will present the background of the study, and the reasons for choosing the subject. This part will also explain the objectives, questions and limitations of the study as well as briefly introduce the theoretical background and research approach chosen.

## 1.1 Background

Europe in general and Finland in particular have been well known for their effective use and conservation of energy as well as the development of renewable energies. In the solar energy field, many companies have obtained many innovations and technological breakthroughs such as NAPS (Finland), SIEMENS (Germany), SUN EDISON (Spain), etc. The price of solar photovoltaic (PV) module (the main part of solar PV system) has been going down significantly. The table below is updated prices of PV module from 2009 to 2011.

Table 1: PV module prices 2009 to 2011

| | Jan-09 (EUR/Wp) | Mar-11 (EUR/Wp) | Price fell to |
|---|---|---|---|
| X-Si, EU | 3.19 | 1.61 | 50% |
| X-Si, China | 2.93 | 1.32 | 45% |
| X-Si, Japan | 3.18 | 1.54 | 48% |
| TF-CdTe | 2.09 | 1.09 | 52% |
| TF-a-Si | 2.21 | 0.94 | 43% |

[pvXchange, 2011]

Besides, because of the rapid financial growth and further R&D of the solar products, the foreign investors have also been trying to look for new international markets in developing countries. Vietnam is predicted to be one of the most potential markets for green energy such as, wind energy, solar energy, and biomass.

The energy market in Vietnam has a lot of potential. The rapidly expanding economy leads to growing energy demand. After more than 20 years of reform progress, Vietnam has achieved significant social and economic achievements. Together with China and India, Vietnam has been one of three fastest growth economies in Asia. Vietnam's economy has grown at a high and steady rate, averaging 7.5% per annual during the last decade [Vietnamembassy-usa, 2010]. It is a fact that energy demand of Vietnam is increasing significantly from 17% to 20% per year in the period 2006 - 2015, exceeding the supply of EVN. At least 4000MW has to be added to the national grid every year in order to meet the demand [unpublished report, Institute of Electricity, MOIT]. According to Deputy Prime Minister Hoàng Trung Hải: "Vietnam still has been facing a lack of energy and will be in the next coming years" [BBC Vietnam, 2010]. The demand for electricity is higher and higher year by year, while oil and natural gas reserves are predicted to become exhausted in the next 20 - 30 years. Vietnam is estimated to start to import a hundred thousand tons of coal per year to supply input for the thermo-electricity companies which are under construction when they come into operation.

Therefore, recently, the Vietnamese Government has been strongly calling for investment in renewable energy projects such as solar, wind, thermal and hydro because of its availability and cleanliness. In the research, the solar energy market in Hanoi was chosen to analyze because of the following reasons.

Firstly, in Vietnam, where there is often plenty of sunshine, the potential to develop solar energy is huge, particularly for business people, farmers and others who want to avoid the serious blackouts that have become prevalent. The country has up to, between 2,000 hours and 2,500 hours of sunshine a year, with solar radiation of 3-3.5 kWh per square meter per day in the winter and of 4.5-6.5 kWh per square meter per day in the summer. Hanoi is in the Northern central area, where the daily average solar radiation is about 3.93 kWh/m2/day and has 1700 - 2000 hours of sunshine a year. The sun resource is good enough for applying solar power. [Prof. Le Chi Hiep, 2009]

Secondly, the currently installed solar PV in Vietnam is about 1.56 Megawatt peak (MWp). The most popular use of this very little solar energy in Viet Nam is for boiling water and most of application areas are now in the South of Vietnam. Vietnam is still nearly an open market in terms of solar power, especially in the North. There are few solar PV systems applied in Hanoi such as the PV system

(12kWp) on the building of Ministry of Industry and Trade, the PV system (154kWp) on the National Convention Center, the PV system (3kWp) on the roof of Hanoi Industry and Trade's building. There is high demand for solar technologies such as solar photovoltaic in Vietnam. However, there are only several companies doing business on photovoltaic in Vietnam. [Prof. Le Chi Hiep, 2009]

Thirdly, Hanoi is one of the most rapidly developing areas in Vietnam with over 10% per year. In Hanoi, the problem of energy shortage has been affecting adversely to daily activities of people and businesses of enterprises. The Hanoians are suffering from the consequence of cutting off electricity in turns.

Moreover, the living standard of people in Hanoi is higher than other provinces. GDP per head of Hanoian is about 1900 USD, 60% higher than the average figure of Vietnam. The figure is much higher if converted to purchasing power parity (PPP) calculation. *"Hanoi and Ho Chi Minh City may be the ideal places for selling home solar PV systems, because the awareness of people and the average income per capita are higher than other areas"* [quoted from a discussion with Mr.Huu, National Load Dispatch Center - ENV, translated by author]. Therefore, if the price is good enough, small solar photovoltaic systems can attract the attention of the people in Hanoi as an alternative solution for electricity cut-off situations.

Vietnam Electricity (EVN) is the only one purchaser in the Vietnamese energy market because of the monopoly in transmission and supply of electricity to citizens. The buying price of EVN is still lowest in the ASEAN region. At present, the price EVN pay for 1kWh imported from China is about 5,8 US cents [Devirenewable, 2011]. So investing in the big solar PV plant in Vietnam is not a good idea if the company does not have the strong and long finance budget because it requires high fixed cost and long payback period.

Based on these backgrounds, after doing desk research and discussing with many friends and experts who are working in the fields, the author realized that small solar PV system may be a suitable alternative solution for electricity cut off situation in Hanoi, and supplying small solar PV systems may be a good business opportunity for foreign companies in the market.

## 1.2 Research objectives, questions, and limitations

**Objectives:**

The main objectives of the research are to analyze solar PV market in Hanoi in order to find the opportunity to supply small solar PV systems to Hanoi and propose a possible business model.

Other objectives of research are:

- To clarify market segments of the business
- To plan a product service system for the business in Hanoi
- To analyze stakeholders related to the business
- To propose an appropriate entry mode for foreign investors

**Questions:**

The main question of the research is "What are the market segments and the business model for supplying small solar PV systems in Hanoi?"

The study will also answer the following questions:

- What is the current solar PV market in Hanoi?
- What are the opportunities and threats for foreign investors in the market?
- Why the small-scale solar photovoltaic system is the business opportunity?
- What is the suitable product and its capacity for the market?
- Who are main stakeholders in the business model?
- Which suitable entry mode can foreign investors choose if they want to do business in the market?

**Limitations:**

The research will focus on solar PV market in Hanoi. Because of the differences between areas in Vietnam, the market segments and business model suggested in the research may not apply to other provinces.

The research focuses only on small solar PV systems, not in solar energy generally. Therefore, the research will just target on households and SMEs as market segments of the product, because they are seen as having the most potential as a target group and because of the scale and the accessibility.

Because of the limited time, there may be not many people and representatives of SMEs take part in the surveys, so their opinions might not be representative opinions of all target customers. Besides, data of the thesis will also be collected by observing the markets and through personal interviews, the data might be subjective.

## 1.3 Theoretical discussion

The research uses many theories related to market research and business model which aim at answering three main questions: What is the situation of the market? What are the market segments of the products? How can we get there and do business successfully? In order to answer these questions, the research will follow the theoretical framework:

- (1). Market analysis, including the analysis of the macro environment and micro environment. Different analyzing tools and methods are used in this research, such as PESTEL analysis, Porter's Five Forces analysis, and SWOT analysis.
- (2). Market segmentation, including the theory about how to segment the market in which management operate, research the need of customers in these segments, and study their characteristics, decision-making processes and buying behavior.
- (3). Business model and strategy, including the theories of the Product Service System (PSS) for the chosen market segments, the business model describing how the business works, the analysis of stakeholders involved and the entry mode strategy.

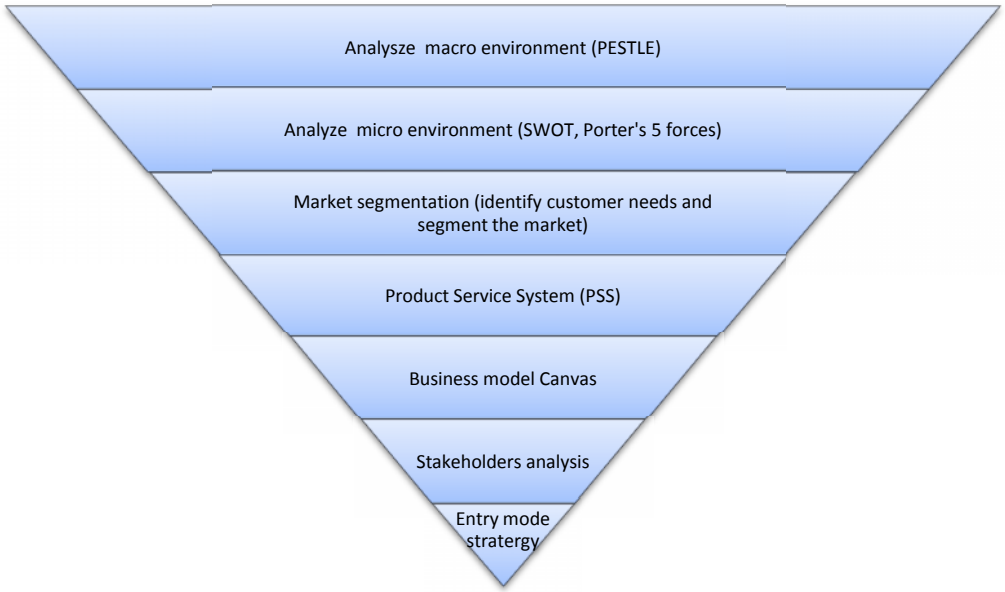



Figure 1: Tools used to describe market opportunity

## 1.4 Research approach

This study will use qualitative research and deductive research approach. The main objectives of the research approach are:

- To understand more deeply about the market
- To convince investor about the business model proposal

Before doing the field research, the author has done desk research from secondary data collected from existing sources, such as internet, journals, articles, other studies. The desk research has helped to define the research, to raise research questions. It is impossible to answer these questions and solve the research problems just by doing secondary research. That is the reason why the author has to develop field research in order to collect primary data.

Firstly, quick internet surveys will be used in order to collect information from potential customers about some issues related. Because of the characteristics of the product, the internet surveys will be sent to two focus groups:

(1) People in Hanoi

(2) Representatives of SMEs

Secondly, in order to understand better about the market and research problems, the author will interview many experts who are working in the field. Interviews will be implemented directly or by email. Focus groups for interview include:

(1) Institute of electricity (Hanoi University of Technology - HUT)

(2) National Load Dispatch Center (Electricity of Vietnam - EVN)

(3) Institute of energy (Ministry of Industry and Trade - MOIT)

(4) Electricity regulatory authority of Vietnam (Ministry of Industry and Trade - MOIT)

(5) Energy department (Hanoi Industry and Trade)

Thirdly, a data set will be created by the researcher from unpublished material, such as some reports from EVN, MOIT, and the related company archives. Besides, in the field research, secondary data and information will continue be collected from reliable sources such as authorized websites, books, studies carried out by other people, reports/publications of WB, HUT, and MOIT.

## 1.5 Structure of the research

The structure of this research follows the phases of the study. The first chapter is the introduction which briefly presents the background, objectives, limitation, and

theoretical discussion of the study. Methodologies and methods are also shortly introduced.

The second chapter explains in details the methods, techniques and processes used to collect and analyze data in this thesis.

The third chapter will include the empirical part of the studies, mostly focusing on the content and the findings of the field research. This phase, empirical field study took place in Hanoi aiming to find information from potential customers in order to position the products into the market. The chapter also includes the recommendation of business model, stakeholders' analysis and suggestion of entry modes.

The last, fourth chapter, will be the conclusions and recommendations for further study.

# 2 RESEARCH APPROACH AND METHOD

The chapter presents research approaches, the qualitative and quantitive methods used for collecting data, the process how to analyze and present findings.

## 2.1 Research approaches

The 4-stage model below illustrates how research activities will progress, from defining what is the research to reporting key findings.

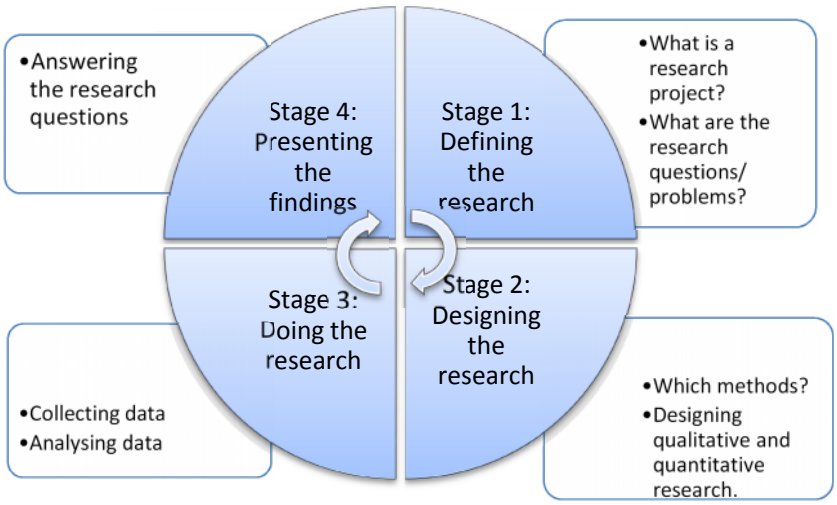



Figure 2: Progress of doing research

[Harvey Maylor and Kate Blackmon, 2005]

The first stage - defining the research - was presented in the chapter 1. As mentioned above, the research was defined after doing desk research and discussing with some friends and experts who are working in the field. It raised the research questions and problems which have to be answered. The chapter 2 will present the stage 2 and 3, including the methods to collect data, to do field research and to analyze data. What data needs to be collected, how to collect it, how to analyze it, and how to present it in the research has to be decided before starting to collect data. The chapter three will answer research questions raised in stage 1, describe the study based on findings collected from field research.

In the research, data collection can be divided into two parts: primary data and secondary data. Each type has different method to collect and analyze.

Primary data is data freshly gathered for a specific purpose. The primary data is the main source of data that this research depends on. It is gathered by the researcher in the target market. It can be collected in many ways, such as through observation, focus groups, survey, behavioral data, experiments. In the research, the technique used to gather primary data is survey, and the instruments used in the survey are individual in-depth interviews with experts and internet surveys. The internet surveys will help the author has opinions of target customers about the product, their needs, their buying behaviors, etc. Interviews with experts working in the field will help the author has better understanding about the market and related issues.

Secondary data is data that is collected for another purpose and already exists somewhere. The secondary data is always collected before the actual research from many reliable resources, whether the problem can be partly solved without collecting costly primary data. Secondary data provides a starting point and offers the advantages of low cost and ready availability.

The research approaches chosen will be presented more detail as well as the way to analyze data.

## 2.2 Secondary data collection and analysis

Secondary data is one of the cheapest and easiest means to access information. Before conducting field research to collect primary data, secondary data is collected and analyzed in order to define and design the research. Secondary data is

also used to analyze market beside primary data, because the data provides general ideas about the market, theoretical knowledge, technical issues. Secondary data is used in the research mainly from:

- An existing data, such as:

  (1) Journals, authorized websites, articles

  (2) Studies carried out by other people, books, articles written about international business development, international project development,

  (3) Reports, publications, national-level research works of recognized institutes or universities in Vietnam.
- A data set created by the researcher from unpublished material such as some reports from EVN, MOIT.

Generally, the steps to collect and analyze secondary data used by author are as follows:

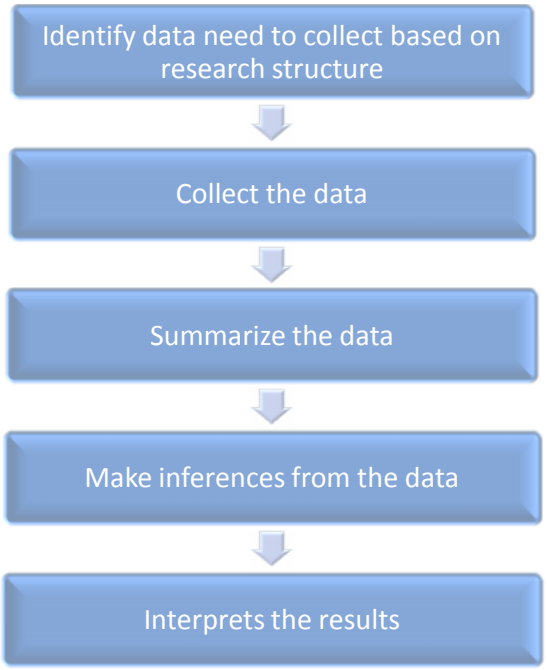



**Figure 3: The process to collect and analyze secondary data**

Based on the research structure, the author will make the list of data need to collect. All needed data will be collected, taken note of and recorded into different groups with sources, public date, main contents and figures. Microsoft Excel will be used to group data into specific groups, in order to summary and analyze data easily for each part of the study.

Secondary data can be a valuable source of information for gaining knowledge and insight into a broad range of issues and phenomena. It complements, but does not replace, primary data collection and should be the starting place for any research.

## 2.3 Primary data collection and analysis

As mentioned above, the technique used to collect primary data is survey.
The survey is a way to collect data from a range of respondents by asking them questions. It is especially useful for capturing facts, opinions, behaviors or attitudes. Survey can be designed in different forms, by different techniques. However, in the research, the researcher used two forms of survey (survey instruments): face-to-face interviews and questionnaires via internet surveys.

### 2.3.1 Internet surveys

There are many ways to do the survey, but in the research, the online survey was chosen because of following reasons:

- The cost of gathering survey information electronically is much less than by traditional means.
- Online surveys are faster to complete since they can automatically direct respondents to applicable questions and be sent electronically to research supplier once finished.
- People tend to be more honest online than they are in personal or telephone interviews.

[Kolter, Keller, Ang, Leong and Tan, 2009, 112]

The figure below is the process to collect and analyze data from internet surveys used by the author.


**Figure 4: The process to collect and analyze data from internet surveys**

The purpose of the internet surveys is that to collect some information related to the potential customers of the small solar PV systems. The data collected are about:

- The situation of electricity supply in Hanoi
- How the lack of electricity affects family or business
- The solutions they chose for the cut off electricity time
- The percentage of households' income/company revenue to pay for monthly electricity.
- Their opinion about the small solar PV systems
- Which capacity of solar PV systems they want
- How much money they are willing to pay
- What they expect from the company supplying the small solar PV systems.

Based on the process and the purpose of the surveys, there are two internet surveys which are designed and sent to two focusing groups - households and representatives of SMEs. The surveys will use 2 languages, Vietnamese and English. In the survey, the researcher uses both open-ended questions and close-ended questions to collect information for the research as well as potential customers' opinions.

After discussing the content of these surveys with teachers and testing the surveys with some friends, the internet surveys will be launched via links in the webpage http://surveymethods.com/

All information collected from the two internet surveys will be tabulated in Microsoft Excel spreadsheets. Based on the data recorded, the author will clean the data. It means that the author has to find and correct any mistake or error, which can be made by both the researcher and respondents who fill in the questionnaire. The author will also check all individual responses and record their answers, both close-ended questions and open-ended questions. Based on responses of open-ended questions, the author may have objective opinions of potential customers about their needs, what they know about the products, what they want from suppliers. It is really useful information to analyze the market segments. Responses from close-ended questions will be recorded into Microsoft Excel spreadsheets. Some forms of picture (such as table, pie chart, bar chart) will be used in order to comprehend a data set more visually.

### 2.3.2 Face-to-face interviews

The in-depth interview is probably the most popular technique in academic qualitative research. In the research, in-depth interviews with some experts in the energy field will be used to collect information. The reason why the method was chosen is that a face-to-face interview is the most versatile method, and it can capture the most detail information (both verbal and nonverbal). The interviewer can ask more questions and record additional observations about the respondent beside what they say, such as body language, the way they talk, information they emphasize.

The figure below is the process which the author uses to collect and analyze data from interviews.

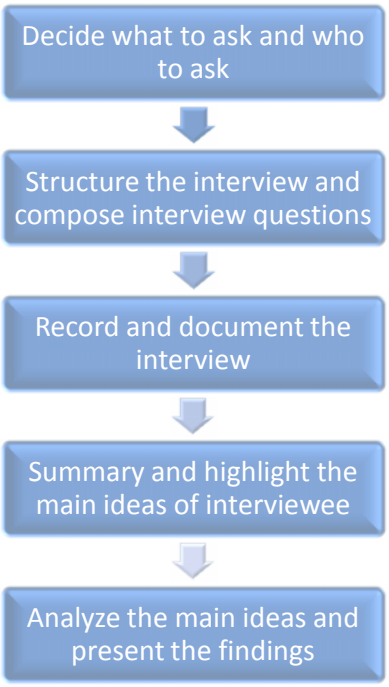



**Figure 5: The process to collect and analyze data from interviews**

All interviews will be taken in the field research are arranged interviews. It means that respondents will be contacted for appointments, and informed about the topic of the interview in advance before the actual interviews. Therefore, they have some time to prepare for the specific topic before interviewing. It is a fact that, the author has discussed and chatted with some experts who are working in the field about some related issues for a long time before, in order to define and design the research. In-depth interviews in the field research will help the researcher have a better understanding about the solar PV market in Vietnam in general and Hanoi in particular.

All interviews will be recorded by digital recorder device and then transcribed everything in the interviews into documents. The author will also take note of the main points from the interviews, discussions and interaction in the interviews. After spending some time reflecting on it, the author will summarize and highlight the main points, which relate to the issues discussed.

The main points and interactions recorded from the interviews are the main sources for analysis. Data displays can simply be selections of text, such as quotes. It is helpful to draw a parallel with quantitive information, and illustrate the analysis, because this data collected from interviews normally could not be

displayed by charts, numbers or other visual displays, that is used to help understand information.

### 2.4 Summary

The chapter has answered the key questions:

- How to design a plan to do the research?
- What methods for collecting data are associated with the scientific approach?
- How to analyze documents or databases?

The target area of the research is Hanoi, capital of Vietnam. The chosen methods are quantitative for collecting opinions from potential customers and qualitative for gathering in-depth data. The main methods for collecting primary data are internet surveys applied for 2 focus groups - households and representative of SMEs, and in-depth interviews with 5 experts working in the field. Additional data will be collected from published and unpublished documents and reports from EVN, MOIT. All information collected from field research will be analyzed by using different methods and processes. Research findings will be presented in more detail in the next chapter.

## 3 MARKET ANALYSIS AND BUSINESS MODEL FOR DOING THE BUSINESS IN HANOI

After the field study in Hanoi in summer 2011, the findings will be presented in the chapter through 3 main stages: market analysis, segmentation of the markets, and business model proposition.

### 3.1 Market analysis

The market analysis consists of two parts: screening through the macro environment and analyzing the micro environment. The international companies must recognize all the key internal and external factors that may influence on the deci-

sion for the products, market segments as well as the business model and strategy. Firstly, general statistics of Vietnamese energy market will be presented.

### 3.1.1 General statistics of Vietnamese energy market

#### 3.1.1.1 Electricity supply situation in Vietnam

The lack of electricity has been being a hot issue in Vietnam for many years. *"Currently the demand for power increases faster than the supply of the system, the electricity demand increases about 16% per year, while the supplying ability of the electricity system increases only 14.1% per year. In year 2010, total commercial electricity of Hanoi was 9.151 billion kWh. The average increasing speed is about 15.5% per year"* [quoted from the interview with Mr. Quang, Institute of Energy, MOIT, translated by author].

*"In recent years, Vietnam's power system was at risk of power shortages, mainly in the late dry season (April through June), especially in dry weather years. In 2010, the system lacked 1.4 billion kWh in the period from April to late June, equivalent to 5% deficit in the three months"* [quoted from the interview with Mr. Vu - Electricity Regulatory Authority of Vietnam - MOIT, translated by author].

*"Some forecasts had said that Vietnam will lack 3 billion kWh of electricity in 2011. This real number will certainly change because the input conditions to calculate this figure will change in practice. It is more difficult to estimate the number of power shortages in Hanoi, because Hanoi is a part of the whole Vietnamese power system. As the capital, Hanoi always comes high on the list of priorities. However, generally top priority places must be given to public places (hospitals, schools ...), residential places in Hanoi still have been suffering from power cut off in turn."* [quoted from the interview with Mr.Huu, National Load Dispatch Center, EVN, translated by author].

With such power shortages, the power will be cut off in turn more frequent in many areas, including Hanoi in comparison with last year. Because of the power shortage situation, foreign and private companies have been encouraged to participate in the market since 2002. Independent power producers (IPPs) are estimated to account for nearly 20% of electricity generating capacity in Vietnam. However,

EVN is still the dominant player for electricity generation, transmission, distribution and sales in Vietnam.

Sector reform has started with the aim to ensure security of supply by creating a competitive market and attracting a broad range of investors in the power sector. On 31 December 2009 the Ministry of Industry and Trade has issued a formal decision to establish design principles for the implementation of the Vietnam Competitive Generation Market. This will include competitive pricing conditions which will increase market potential for sustainable energy development. The issue will be presented in more detail in the legal part. In this part, the electricity supply of Vietnam will be described.

The electricity production increased rapidly about 14% per year in the last 10 years. The total capacity of domestic power plants in year 2010 reached 94,472 million kWh [EVN, 2011]. The table and the figure below show the detail of electricity production in Vietnam in the last 10 years. These figures do not include the imported electricity.

Table 2: Electricity production of Vietnam from 2000 to 2010

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Capacity (Million kWh) | 27040 | 31137 | 36410 | 41275 | 46751 | 53264 | 60567 | 66069 | 72735 | 82917 | 94472 |

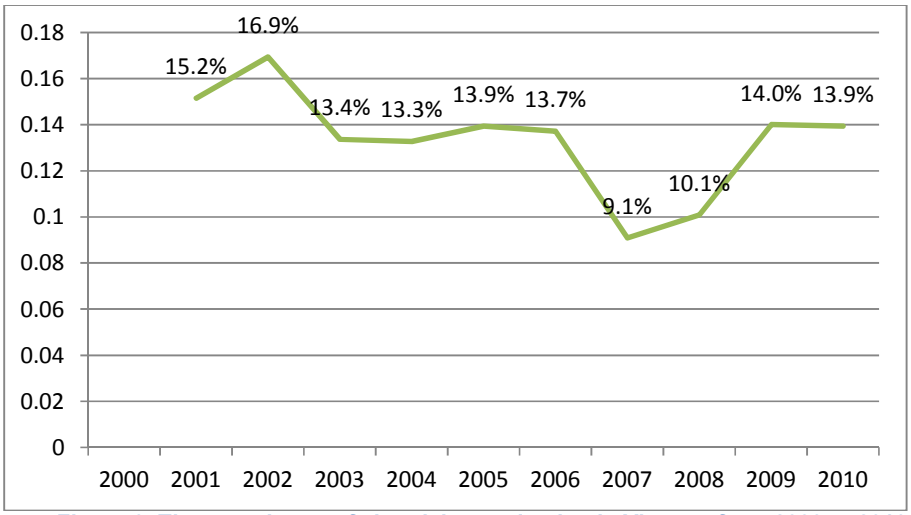



Figure 6: The growth rate of electricity production in Vietnam from 2000 to 2010

[Unpublished report, EVN, 2011]

The vast majority of electricity supply in Vietnam originates from gas turbine, coal-fired and hydro-electric power plants. These sources continue to be important. In addition, natural gas-fired power plants have emerged as a major new

source of electricity supply. Reports from EVN indicate that these 3 types of electricity always account for 90% in total electricity structure of Vietnam. The figure below illustrates the electricity generating mix structure of Vietnam in recent years.

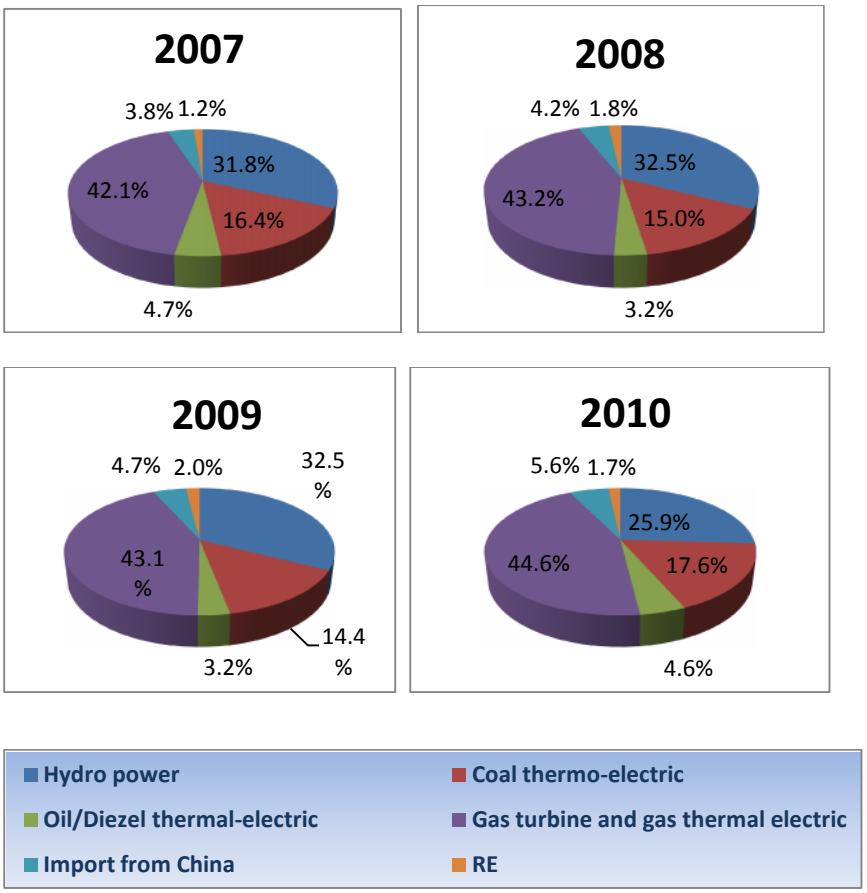



Figure 7: Electricity generating mix structure 2007 - 2010

[Unpublished report, EVN, 2011]

Despite the fact that the electricity production increases significantly with average speed about 14% per year in the last 10 years, the demand for electricity increases even faster, with the average speed 16% per year. That is the reason why Vietnam started to import energy from China since 2004. The imported electricity figure is growing significantly year by year. At present, the electricity imported from China accounts for 5.6% in total electricity supply of Vietnam.

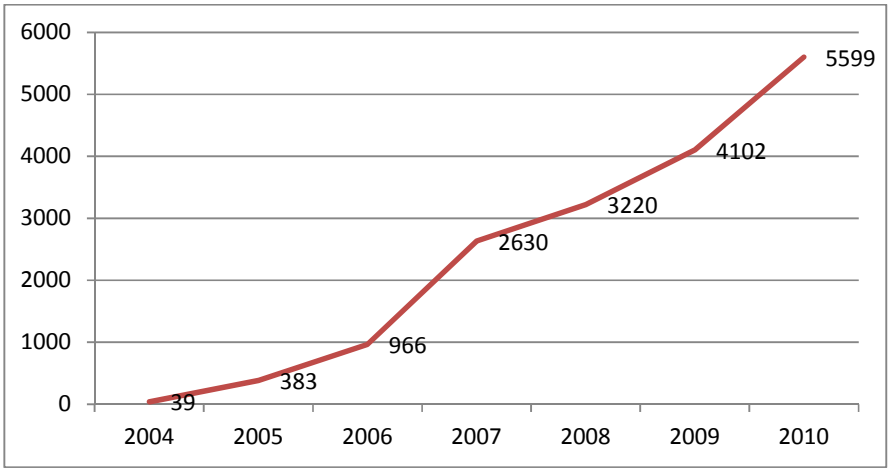



Figure 8: Amount of electricity imported from China (million kWh)

[Unpublished report, EVN, 2011]

Clean energy capacity was always less than 2% in total capacity of electricity supply in Vietnam, mostly from small hydro power plants. The other types of renewable energy accounts for really small capacity in total electricity supply of EVN.

### 3.1.1.2 Solar PV in Vietnam and Hanoi

Nowadays, the development of renewable energy in Vietnam has become urgent, when the exploitation of hydropower potential has been basically completed, power from coal has reached its limit, Vietnam Electricity (EVN) will even have to import coal for electricity in the near future. MOIT and EVN are building the strategy and master plan for developing renewable energy (RE) in Vietnam up to 2030, with a vision towards 2050 [Thanhnien, 2011]. They also implemented many plans and programs in order to solve the power shortage problem, such as programs encouraging people to use compact lamps, solar water heaters. However, the current market for energy efficiency (EE) and renewable energy (RE) in Vietnam is still limited in size, but it is definitely emerging and its growth potential is high, given the rising awareness, resulting from continued economic and demographic growth. The subsequent increase in energy demands, will need to be matched in the medium and long term by a more diversified energy mix and investments in a more sustainable and low carbon growth path.

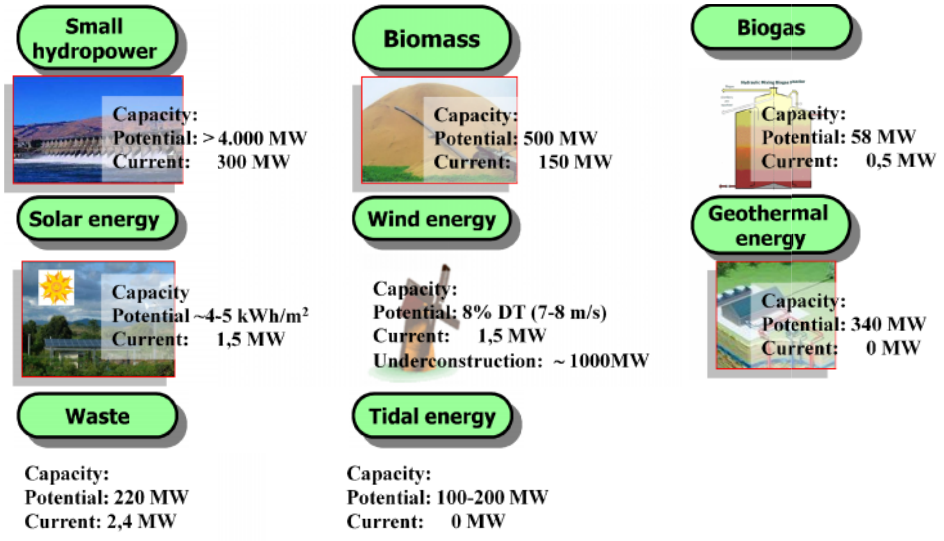



Figure 9: Potential and current capacity of RE in Vietnam

[Unpublished presentation, MOIT, 2010]

It is a fact that most current solar photovoltaic projects in Vietnam are conducted in rural and mountain areas in which the national transmission grid cannot reach up to now. These projects mainly granted by foreign organizations and Vietnamese government.

There are two main forms of solar power in Vietnam - solar heat water systems and small solar PV systems. Up to now, Vietnam has more than 1.56 MW of solar PV installed solar photovoltaic systems used for generating electricity in small home systems, telecommunications, hospitals, schools, traffic, etc.

According to interviewed stakeholders' opinions, the main reasons of the unpopularity of small solar PV systems in the market are the high price of the system, and there are no manufacturers or distributors recommending the solution and analyzing the effectiveness of the systems.

Table 3: Installed capacity of solar PV, the rate of application by October 2009

| | Telecommunication/post stations | Villages' head offices, schools, etc. | House-holds | Traffic | Others | Total |
|---|---|---|---|---|---|---|
| **Capacity (kWp)** | 145,140 | 375,065 | 145,316 | 250,000 | 315,109 | 1,560,630 |
| **Percentage (%)** | 30,5 | 24 | 9,3 | 16 | 20,2 | 100 |

[Unpublished report, Institute of Energy - MOIT, 2010]

There are few solar PV systems installed in Hanoi, such as the solar PV (12kWp) on the roof of Ministry of Industrial and Trade, solar PV system (154kWp) in the National Convention Center, solar PV (3kWp) on the roof of Hanoi Industry and Trade department.

Figure 10: Picture of the 12kWp solar PV system on the roof of MOIT's building

Figure 11: Picture of the 154kWp solar PV system in the National Convention Center

[devi-renewable, 2011]

Solar energy at the level of industry, as well as small PV systems for households in big cities, such as HCM city and Hanoi is really open in Vietnam at the moment.

*"I surely think that the solar PV solutions for households have to be applied in Vietnam. The questions are suitable time to come, and which company come into the market first. Hanoi is an open market for the solar PV distributors"* [quoted

from interview with Mr.Thang - Manager of Energy Department - Hanoi Industry and Trade, translated by author].

There are only around 10 domestic small-medium size enterprises and organizations participating in the market of manufacturing solar-absorbed panels and solar water heater equipment. First Solar Inc. seems to be the first foreign player who started to build an advanced thin-film photovoltaic modules manufacturing plant in Vietnam in October 2010.

The market analysis below will present more detail information about solar PV market in Hanoi.

### 3.1.2 PESTLE analysis

Before investing in any market, the companies have to screen through the macro business environment of the country. The macro environment includes factors like political and legal, economic, social and cultural, etc. One effective tool to analyze the macro environment is PESTLE. There are six different topics under investigation: The **P**olitical situation and stability, the **E**conomical conditions in the country, important **S**ocial facts, **T**echnological aspects concerning solar power, **L**egal aspects with respect to (foreign) investments for solar power and **E**cological (or Environmental) characteristics. This useful tool aims at a general overview about the most important facts but does not claim completeness.

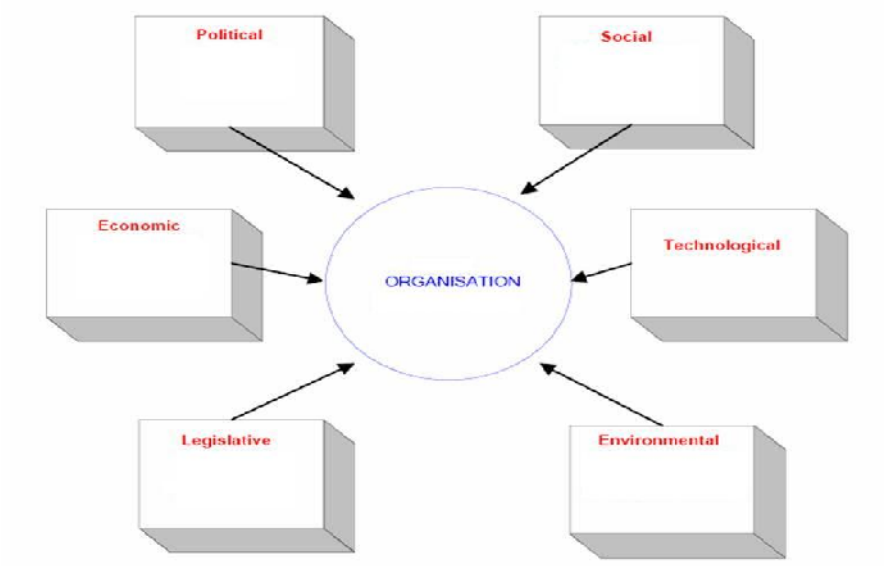



Figure 12: PESTLE analysis framework

The PESTLE analysis provides the general picture about Vietnam in general and Hanoi in particular. It helps to answer the 6 main questions:

- What are the key political factors likely to affect the industry?
- What are the important economic factors?
- What social aspects are most important?
- What technological innovations are likely to occur?
- What current and impending legislation may affect the industry?
- What are the ecological characteristics?

[Marketingminefield a, 2011]

#### 3.1.2.1 Political

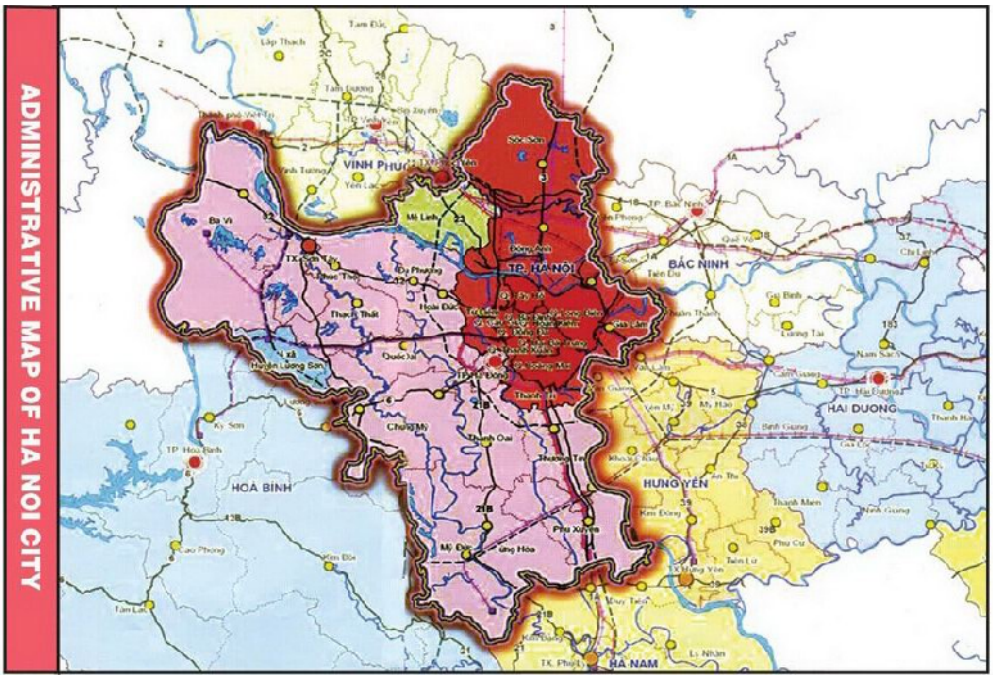



Figure 13: Administrative map of Hanoi

[Hanoi.gov.vn, 2009]

The capital Hanoi is the most important political centre and second-largest city of Vietnam. It is a fact that Hanoi and other provinces are under the leadership of Vietnamese Government.

The Socialist Republic of Vietnam is governed by a one-party authoritarian regime. Vietnam has been retaining successfully the political stability over last decades because of the single party system. However, politicians also assess Vietnam

to possess high risk of the political instability in long-term because of this single party system.

The Vietnamese legal system in general still contains inconsistencies and overlapping and conflicting at several points, leading to difficulties, even misinterpretation in application and enforcement at the grass-roots level. In fact, this government has tried to reform step by step its legal system in order to make it more efficient. Currently, the Vietnamese government is implementing the Strategy on the Development of the Legal System. The Strategy first focuses on reviewing the entire system of normative acts to remove those that are overlapping, conflicting or out-dated, ensure the constitutionality, consistency, enforceability, openness, transparency, and accessibility of the normative acts. Because of that, plenty of bureaucracies have been cutting down.

Corruption is perceived as widespread. Vietnam ranks 116th out of 178 countries in Transparency International's Corruption Perceptions Index for 2010 with a score of 2.7. Complicated legal system, corruption and bureaucracy are the 3 main reasons to make the administrative procedures to set up a business in Hanoi longer than some provinces of Vietnam. The table below presents the length of business registration in Hanoi

Table 4: Length of business registration in Hanoi

| Indicator | Value |
|---|---|
| Percentage of firms having difficulty obtaining all licenses and permits necessary to do business. | 8.89 |
| Percentage of firms waiting more than three months to complete all steps necessary to start operations. | 31.85 |
| Length of business registration in days (Median). | 15 |
| Length of business re-registration in days (Median). | 9.25 |
| Number of licenses and permits necessary to start operations (Median). | 7.08 |
| Wait for Land Use Rights Certificate (Median). | 2 |
| Percentage of firms waiting over a month to complete all steps necessary to start their business | 90 |

[PCIVietnam, 2010]

Corruption in Vietnam is due in large part to a lack of transparency, accountability, and media freedom as well as low pay for government officials and inadequate systems for holding officials accountable for their actions. A confused overlapping of regulatory jurisdictions and bureaucratic procedures creates opportunities for corruption. The corruption in Vietnam can be frustrating to Western companies. Fortunately, Vietnam's pursuit of more comprehensive business reform has progressed in recent years. Administrative procedures have been streamlined, and the regulatory framework for smaller businesses has been improved. [index of economic freedom, 2011]

The government has made progress in liberalizing its trade regime since joining the World Trade Organization in 2007, but some import bans and restrictions, services market access barriers, import licensing requirements, non-transparent regulations, state trade in some commodities, weak enforcement of intellectual property rights, corruption, and customs inconsistencies add to the cost of trade. However, there are some incentives from Vietnamese government related to sustainable technologies in general and renewable energy in particular. The incentives will be presented more detail in the Legal part of the analysis.

In Vietnam, the Ministry of Industry and Trade's Energy Department is responsible for the development of its energy policy. At the provincial level, Industrial and Trade Departments are responsible for implementing the national policies. According to the MOIT's report "Strategic master plan for developing renewable energy in Vietnam", Vietnam is striving for increase the proportion of renewable energy sources to about 5% in the year 2020, and 11% in the year 2050. It focuses attention on renewable energy by stating that "development of various forms of renewable energy needs to be encouraged".

#### 3.1.2.2 Economical

There are many elements of economy which the foreign investor has to analyze, such as: GDP, currency, inflation, interest rate, and FDI inflow.

**GDP of Hanoi**

Economic Hanoi economic growth is always among the "top" provinces of Vietnam. In 2010, Hanoi's GDP accounted for 12.73% nationwide (equal to

half of Hochiminh city's GDP, 3 times higher than GDP of Hai Phong and 7 times higher than GDP of Da Nang) [dvt.vn, 2011].

The economy of Hanoi in the past two decades consistently achieved higher growth rates than the national rates. The average rate during the period 2001-2005 is 11.24%, from 2006 to 2009 is 10.22% (the Vietnam growth rates at those periods are 7.51% and 7.08%). In 2010, the total gross domestic product (GDP) of Hanoi increased 11% compared to 2009, (industry increased 11.6%, the service industry increased 11.1%, agriculture, forestry, and aquaculture increased 7.2%) [General statistic office, 2010]

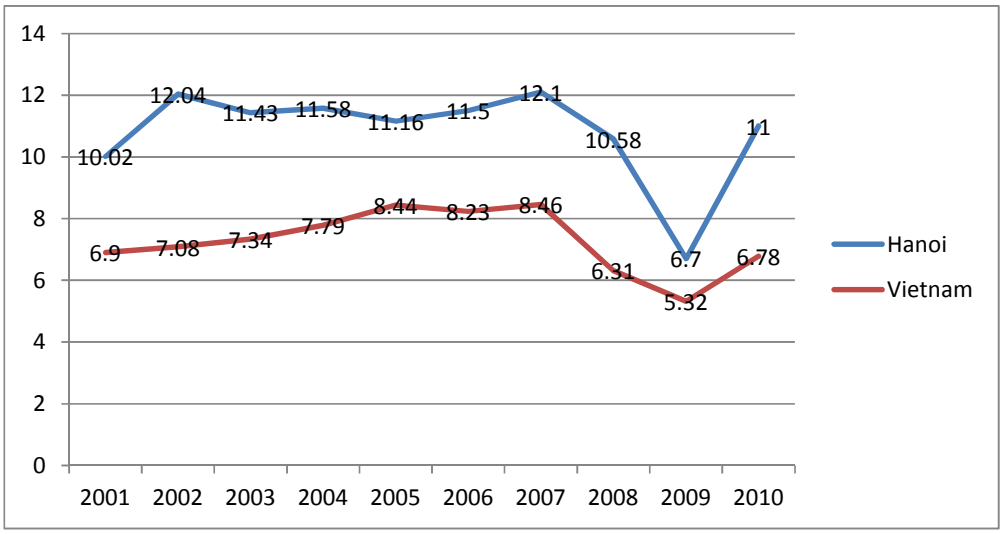



Figure 14: GDP growth rates of Hanoi in comparison with Vietnam

[General statistic office, 2010]

Due to the growth of Vietnamese economy in recent years, Hanoi and Ho Chi Minh City are projected to be the top two cities having the worlds highest average real GDP growth from 2008-2025, according to a recent article published in the UK Economic Outlook.

Table 5: Top 10 urban agglomerations by projected average real GDP growth in 2008-2025

| Growth rank | City | Country | Average real GDP growth in 2008-25 (% per annum) |
|---|---|---|---|
| 1 | Hanoi | Vietnam | 7.0% |
| 2 | Ho Chi Minh City | Vietnam | 7.0% |
| 3 | Changchun | China | 6.9% |
| 4 | Guangzhou | China | 6.8% |
| 5 | Addis Ababa | Ethiopia | 6.8% |
| 6 | Xian | China | 6.7% |
| 7 | Surat | India | 6.7% |
| 8 | Beijing | China | 6.7% |
| 9 | Jaipur | India | 6.7% |
| 10 | Lucknow | India | 6.6% |

[PricewaterhouseCooper, 2009]

Vietnam's robust economic growth results in a considerable increase of personal income. Nowadays, Vietnam has been removed from the list of low income countries and has become a middle income one. Hanoi is the economic center in the North and the second largest city of Vietnam. The average income of a Hanoian is always 60% higher compared with the national average in recent 5 years. The chart below shows the GDP per capita of a Hanoian in comparison with the average of Vietnamese (Unit: USD). [The author has used the statistics of General Statistic Office of Vietnam and average exchange rate of each year from 2005 to 2010 in order to convert the figures from VND to USD]

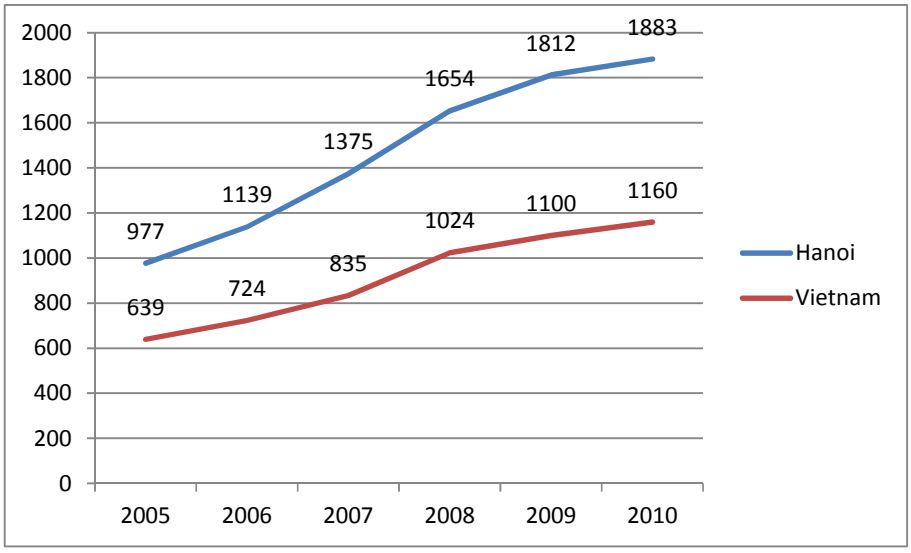



Figure 15: Annual GDP per capita in Hanoi and Vietnam

[General statistic office, 2010]

The continuous GDP per capital growth surely leads to higher living standards of people, especially people living in big cities, such as Ho Chi Minh City or Hanoi. This promises to create a sizeable market for sustainable business in general and small solar PV systems in particular. "*Hanoi and Ho Chi Minh City may be the ideal places for selling home solar PV systems, because the awareness of people and the average income per capita are higher than other areas"* [quoted from Mr. Huu - EVN, translated by author].

**Currency**

The Vietnamese State Bank has been applying a tight monetary policy. Vietnam Dong went down vis-a-vis developed market currencies such as the US Dollar or the Euro. The chart below is the 10 years history of exchange rate between VND and USD.


Figure 16: 10 years history of exchange rate between VND and USD

[Xe.com, 2011]

Vietnam devalued the Dong recently by 8.5% due to rampant inflation and high interest rates. The International Monetary Fund describes its foreign-currency reserves as being "low." While the whole of Asia outside Japan is struggling to curb inflation, countries such as China, Taiwan and Singapore have strengthening currencies and rising foreign- exchange reserves.

**Inflation**

In 2007, Vietnam joined the World Trade Organization. Vietnam now boasts one of Southeast Asia's fastest-growing economies, which is driven primarily by tourism and exports, but it also has a serious inflation problem and has struggled to attract more investment.

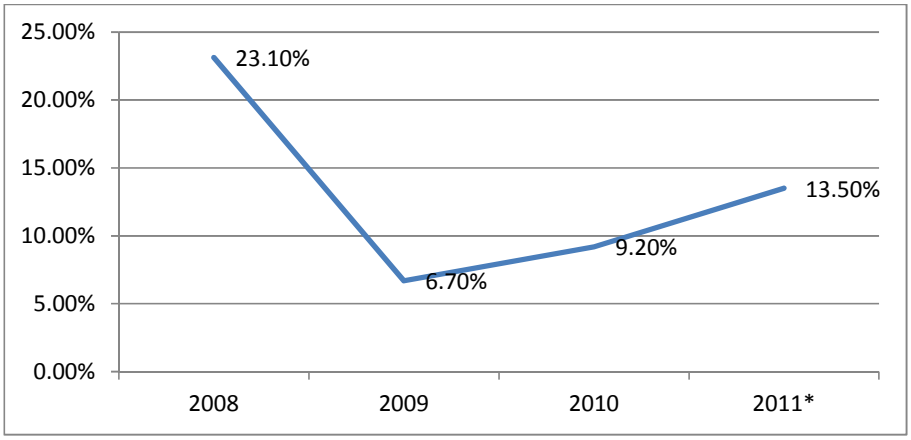



Figure 17: Inflation in Vietnam in recent years

Note: 2011 estimate

[Global finance, 2011]

Inflation has been high, averaging 10.9 % between 2007 and 2009. The government influences prices through regulation, subsidies, state-owned enterprises, banks, and utilities.

**Interest rate**

Despite the large number of small banks, the four primary state-owned banks control most lending. The interest rate of Vietnamese banks is really high. According to the decision 2868/QD-NHNN of State Bank issued on 29/11/2010, the base interest rate applying is 9%. The interest rate applied in commercial banks is higher, about 14%. The chart below illustrates the base interest of Vietnam from 2004 to 2010.


Figure 18: Vietnam base interest rate 2004 - 2010

[The State bank of Vietnam, 2011]

Because of the high interest rate, these are warnings of macroeconomic instability in Vietnam. It can reduce belief of investors and increase ability of leaving the market if local government has no response to tighten these policies.

**FDI inflow**

Table 6: FDI in Vietnam and Hanoi in recent years

| | Hanoi | | | Vietnam | |
|---|---|---|---|---|---|
| Year | Rank | Number of projects | Registered capital (million USD) | Number of projects | Registered capital (million USD) |
| 2008 | 3 | 1349 | 18,864.6 | 10,105 | 159,764.5 |
| 2009 | 8 | 219 | 656.7 | 839 | 21,482.1 |
| 2010 | 12 | 225 | 311.3 | 969 | 18,595.5 |

[FDI reports - 2008, 2009, 2010, Ministry of Planning and Investment - MPI]

The table shows that Hanoi is always in the top of provinces attracting most FDI. Because of the world crisis, the FDI flow reduced rapidly in Vietnam in general and Hanoi in particular in the year 2009, 2010. However, the trend started to increase again in 2011. Up to July 2011, there are 112 new projects registered in Hanoi, with 428 million USD of registered capital, ranked number 4 in the total of 63 provinces of Vietnam [FDI report, MPI, 2011].

3.1.2.3 Social

There are some main aspects of social will be presented in this part, such as: population growth, education, qualification of population, population structure, unemployment, and employment structure by occupation, living standard.

**Population growth**

The current population of Hanoi was about 6,541,909 and its annual population growth rate averaged 2% in the period 1999-2009. This rate is 2.2 times as high as that of the Red River Delta and 1.66 times higher than the national average. Migration to Hanoi is considered one of the main causes of Hanoi's higher population growth rate than that of the national average.

Table 7: Population Growth Rate, male/female Ratio in 1999 and 2009

| Province/ City | Average population growth rate 1999-2009 (%) | Male/female ratio (%) | |
|---|---|---|---|
| | | 1999 | 2009 |
| Country | 1.2 | 96.7 | 98.1 |
| Red River Delta | 0.9 | 95.8 | 97.2 |
| **Hanoi** | **2.0** | **97.7** | **97.0** |

[General Statistics Office, Vietnam 2009 Population and Housing Census]

The table shows that the male/female ratio increased to 98.1 males per 100 females in 2009. Comparing to the national average, the ratio of Hanoi is 0.11 % lower.

**Education**

Hanoi is the largest centre of education in Vietnam. In 2009, Hanoi has 677 primary schools, 581 junior secondary schools and 186 high schools and over 90 universities and colleges. It is estimated that 62% of the scientists in the whole country are living and working in Hanoi.

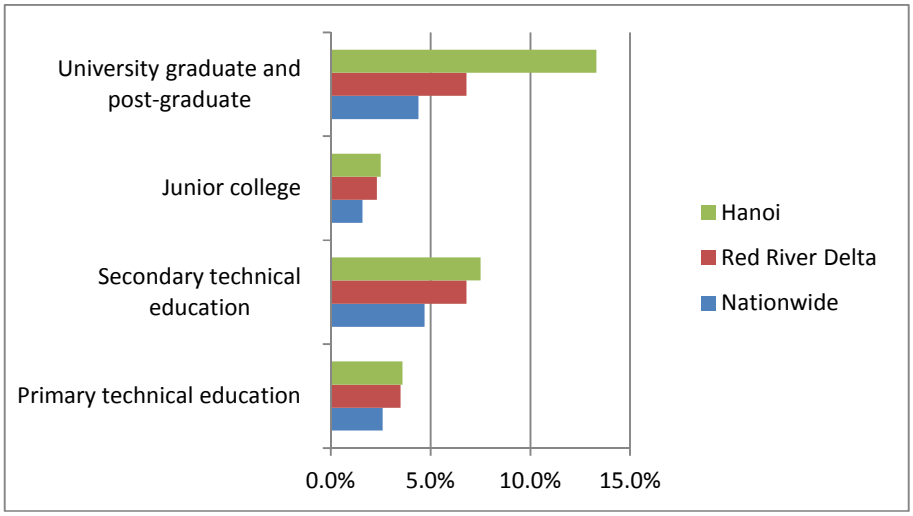



**Figure 19: Hanoi's population structure (above 15 years of age) by professional/technical qualifications (%)**

[General Statistics Office, Vietnam 2009 Population and Housing Census]

The above figures show that about 27% of the population aged 15+ in Hanoi has received technical and professional training in different levels, of which 15.8% have junior college or university education. This is a huge and precious human resource (four times higher the nationwide average). However, this also reflects the imbalance in population by qualifications when there are more "professors" (16% graduates or post graduates) than "skilled workers" (11% technical/ vocational school graduates).

Although the percentage of population aged 15+ in Hanoi with higher professional qualifications is 2 times higher than the nationwide average (13.3%) and 1.3 times higher than that in Red River Delta (19.4%), this figure is still considered low, particularly in rural areas of Hanoi. This is a major obstacle to the demand for high-quality labor force in the process of industrialization and agriculture modernization.

**Table 8: Qualifications of Hanoi's population aged 15+ by rural/urban areas in 2009**

| | Population aged 15 + | Qualifications | | | | | |
|---|---|---|---|---|---|---|---|
| | | Untrained | Primary | Secondary | Junior college | University graduate & post graduate | Un-identified |
| **Hanoi** | 4,967,925 | 3,628,855 | 178,742 | 373,823 | 125,429 | 660,219 | 857 |
| **Urban areas** | 2,078,804 | 1,152,485 | 107,761 | 210,453 | 65,231 | 542,435 | 439 |
| **Rural areas** | 2,889,121 | 2,476,370 | 70,981 | 163,370 | 60,198 | 117,784 | 418 |

[General Statistics Office, Vietnam 2009 Population and Housing Census]

The figures show that there is a big difference in professional qualifications by rural/urban areas. 85.7% of Hanoi 's rural population aged 15+ have not been trained professionally, the rate for urban areas is 55.4%, 2.14 times lower than that in rural areas.

The figures also present that Hanoi has a young population structure. There are approximately 5 million Hanoians in working age, accounting for 76% of total population. It is said that Hanoi now has a golden population for growth and development. It opens for the city many chances to develop as well as for foreign investors to invest in the market.

**Labor - employment structure**

The unemployment rate of Hanoi's population aged 15 and above stands at 2.17% (4,967,928 people), of which males account for 57.3% and females 42.7%. The unemployment rate in rural and urban areas is 50.08 and 49.92% respectively.

**Table 9: Hanoi's population aged 15+ by economic status, gender, rural/ urban areas (people) in 2009**

| | Hanoi | | | Urban areas | | | Rural areas | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Males | Females | Total | Males | Females | Total | Males | Females |
| Employed | 3,288,470 | 1,646,599 | 1,641,871 | 1,187,907 | 607,697 | 580,210 | 2,100,563 | 1,038,902 | 1,061,661 |
| Unemployed | 108,061 | 61,943 | 46,118 | 54,119 | 30,127 | 23,992 | 53,942 | 31,816 | 22,126 |
| Not involved in economic activities | 1,557,394 | 678,923 | 878,471 | 832,995 | 357.722 | 475,233 | 724,439 | 321,201 | 403,238 |
| Unidentified | 14,003 | 8,522 | 5,481 | 3,825 | 1,924 | 1,901 | 10,178 | 6,958 | 3,580 |

[General Statistics Office, Vietnam 2009 Population and Housing Census]

Analysis of employment structure by occupations indicates the diverse forms of employment, which facilitates the understanding of corresponding qualifications to each form of employment. Foreign investors can use the figures to estimate their potential market size. The following table shows Hanoi's employment structure by occupations in 2009.

Table 10: Hanoi's employment structure by occupations in 2009

| Occupations | Hanoi | Urban areas | Rural areas |
|---|---|---|---|
| Leadership | 49,617 | 39,391 | 10,226 |
| High-level technology | 445,702 | 359,728 | 85,975 |
| Medium-level technology | 149,955 | 80,601 | 69,353 |
| Office staff | 75,205 | 51,191 | 24,014 |
| Private service, security, sales | 530,695 | 294,391 | 236,305 |
| Agriculture, forestry and fisheries | 21,747 | 4,094 | 17,653 |
| Handicraft and other related fields | 553,537 | 128,431 | 425,106 |
| Technicians and operators | 250,247 | 121,468 | 128,799 |
| Other simple jobs | 1,211,763 | 108,612 | 1,103,151 |
| **Total** | **3,288,470** | **1,187,907** | **2,100,563** |

[General Statistics Office, Vietnam 2009 Population and Housing Census]

In urban areas, there is a high percentage of people working in such areas as leadership, high-tech, mid-tech, private service, security and sales, while in rural areas agriculture, forestry and fisheries, handicraft, and other simple jobs.
One of the most attractive factors in Vietnam to the foreign investors is cheap labor costs. In recent years, the government has increased the minimum wage rate in domestic and foreign-invested enterprises. Since 1/10/2011, the minimum wage will be increased, from 1.4 million to 2 million VND/ month depending on areas [Decree 70/2011/NĐ-CP]. Even though people in Hanoi and Ho Chi Minh are paid the highest rate, the minimum wage is still low.

**Standard of living**

As mentioned before, GDP per capita in Hanoi is the second highest in Vietnam, after Ho Chi Minh City. Hanoi is the center of politics, education of Vietnam, and the center of economy in the North. It leads to the higher living standard as well as creates sizeable market for foreign investors in comparison with other provinces.

3.1.2.4 Technological

The technological factor includes the related support ***infrastructure factor***.

**Transport:**

Hanoi has a synchronous and developed transport system. Noi Bai International Airport is 40 km away from its center. Hai Phong Port and Cai Lan Port (next to

Ha Long Bay- an international cultural heritage), 120 km out of Hanoi, are invested for cargo import and export. Hanoi has rather good roadway and railway systems, creating a vital transport axis of northern Viet Nam.
Hanoi is also an in-transit center for Northern provinces of Viet Nam, near to cities of Southern China and Laos. It is a favorable place for the trading and distribution of goods.
**Power supply:** Hanoi currently has 7 electric stations 200kV and 500kV lines, 23 10-kV electric downloading stations. A 22kV line in urban and neighboring areas is designed. However, the grid of Hanoi is quite old, the circuit does not perform well, and that is one of the reasons for electricity cut off sometimes.
**Communications:** Hanoi is the biggest communications center in the country. Its communications network satisfies swift communication information demand nationwide and worldwide.

[Vietnam trade promotion agency, 2011]

**Urban architecture:** according to many people's opinions, the urban architecture of urban in Hanoi is not good, especially in the center. There are many new urban areas (79 new urban areas in Hanoi) which have good architecture designs. However, narrow-street long houses are most popular in the center of the city. There may be not enough space for installing solar panels on their roofs nor space for equipment to ensure the safety of the electric system.

#### 3.1.2.5 Legal

New legislation and policies in support of RE are in the making and they include financial incentives. An important element in fostering an enabling environment for RE market development is the new Law on Energy Saving and Efficiency, which has come into force since 1 January 2011.
Another milestone for positive market incentives is the national target program in response to climate change (NTP-RCC), which was approved by the Prime Minister in December 2008 and which includes incentives for public and private sectors to prepare mitigation actions and decrease emissions.
Energy security and savings, cleaner production and emission reductions will remain priority issues on the Vietnamese political agenda for years to come and will create tremendous market opportunities for trade and investment.

The Law on Environmental Protection (2005) includes compulsory assessment tools like the Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) which are intended to attach environmental considerations to decisions on plans and investments and provide solutions for environmental safeguards. While in the past five years the Vietnamese government has basically neglected to ensure practical application of these legal tools, there is now a new momentum coming up for broader implementation and this is expected to generate better awareness amongst public sector investors as well as business managers about benefits and cost-effectiveness of investing in a sustainable energy supply chain. [Vietnam sustainable energy sector, 2010]

Some of the basic related regulations were mentioned above. Foreign investors have to take into consider many laws and regulations of Vietnam if they want to do business in the market. The Appendix 3 is the list of related policies for foreigner investors want to do business in the renewable energy market. This part will just present some incentives from Vietnamese government and obstacles from Vietnamese legal systems for foreign enterprises who want to join into the RE field.

**Incentives:**

**General policy of Vietnam:** *"Developing the energy structure comprehensively: electricity, petroleum, coal, and renewable energy. The concern is to develop clean energy, giving priority to develop new and renewable energy..."* [Article 1, the energy development strategy of Vietnam up to 2020 with a vision towards 2050]

The Vietnamese government's Decision No. 1855/QD-TTg (2007) presents the Vietnam energy development strategy up to 2020, with a vision towards 2050 and targets for a share of 3% renewable in 2010, 5% in 2020 and 11% in 2050 of the total amount of commercial primary energy.

The government Decision No. 110/2007/QD-TTg plans additional capacity of renewable electricity in the future to consist of 241 MW/year in the period 2006 to 2015 and 160 MW/year in the period 2016 to 2025, equaling a total 4050 MW renewable electricity capacity by the year 2025.

**Tax incentives:**

The income tax rate is 10% applied in the first 15 years for new businesses investing in projects to develop power plants. If these projects are classified as large-

scale projects, high tech or special needs to attract investment, the time to apply this preferential tax rate maybe longer than 15 years, but less than 30 years.
Import tax exemption for machinery and equipment imported to create fixed assets for investment projects to build new power plants.

**The incentives apply to CDM (clean development mechanism)**

The CDM projects can apply accelerated depreciation for fixed assets
CDM projects are entitled to exempt land rent fee within seven years after the projects go into operation
CDM projects which have production costs higher than the actual sale signed in the contract can request subsidies for the products of the project from the Environmental Protection Fund of Vietnam.

[Decision 130/2007/QD-TTg]

According to the Decision 26/2006/QD-TTg approved the road map and conditions for establishing and developing levels of the Vietnamese electricity market, Vietnam will have complete competitive retail electricity market from the year 2024 onwards:

- 2005 - 2014: competitive generate electricity market
- 2015 - 2022: wholesale competitive electricity market
- After 2022: the retail competitive electricity market (from 2024 onwards: the complete competitive retail electricity market). In the market, customers can choose freely the retail distributors or purchase electricity directly in the electricity spot market. Individuals and organizations are eligible for licensing the establishment of the retail electricity business.

Besides the incentives from Vietnamese government, *"there are many encouragements from Hanoi, such as no import duties on equipment, business premises, etc. If foreign investors want to invest in the renewable energy market in Hanoi, I am sure that Hanoi will seek many ways to assist them"* [quoted from Mr.Thang, manager of Energy department, Hanoi Industry and Trade, translated by author].

**Obstacles for the development of renewable energy.**

The retail prices of electricity are still low, even lower than the production cost. At the moment, the retail electrical price is about 6.5 US cents per kWh. Therefore, it does not encourage people to install their own renewable energy as well as foreign investors invest large scale in green energy.

**The monopoly of EVN impedes the investment in renewable energy**

The EVN - the only buyer, distributor, transmitter and regulator really discourages investors, because the renewable energy plants cannot sell power at market prices, which is affecting to their ability to cover costs and gain profit. Moreover, the monopoly of EVN leads to the lack of private investment in the energy sector. It will cause power shortages, unimproved infrastructure, lack of investment in renewable energy, and affect to the use energy efficiently. However, it is a chance for selling small electric systems (small solar PV, small scale wind turbine, Pico hydro, etc) for households and SMEs.

**The strict regulations for independent power projects**

Independent power projects must conform to the program/strategy of EVN. If the project is not yet in the power development plan, it has to apply for the permission from the Prime Minister or Ministry of Industry and Trade before planning to invest. Moreover, investors have to attain the written approval to buy electricity from EVN before applying for investment licence. A lending commitment from banks has to be achieved before the project will be granted the investment certificate also.

**The regulations are not clear about the BOT projects**

Regulations are unclear about which state agency has jurisdiction to make which kind of guarantee to investors. Article 38 of Decree 78/2007/ND-CP: "*When necessary, depending on the characteristics of the project, the government will assign the competent agency on behalf of government to guarantee for the loan to provide materials, to consume products and to do other contract obligations with investors or other enterprises participating in the execution of projects, identified in the project contract. The assigned State agency also guarantees for the obligations of State enterprises exclusive sell raw materials, or purchase products and services of the project"* [Translated by author]. Currently, the Ministry of Finance is an authorized agency to issue governmental guarantees for foreign loans. However, other guarantees are unclear, such as the responsibility of the buyer of products and foreign exchange risks.

The Government has difficulty guaranteeing for large scale BOT power projects. The Government's guarantee by foreign currency may not be enough for investors/lenders of the large scale projects. Loans with maturity from 1 to 12 years, the Ministry of Finance can provide guarantees worth $ 400 million per year. Moreover, the Government guarantee is limited by the "Enhanced Structural Adjustment

Program" (ESAP) of the IMF. Despite the fact that the limitations have expired in 1998, Vietnam still follows these restrictions. [Duane Morris Vietnam, 2009]

### 3.1.2.6 Ecological

Hanoi is the capital of Vietnam, the center of political and the second largest city of Vietnam.

**- Natural** area**:** 3,400km2.

**- Climate:** Hanoi lies on a tropical monsoon region; summer is hot and rainy, and winter is cold. There are 4 seasons: spring (from January to April), summer (from May to August), autumn (from September to December), and winter (from December to January of the following year).average annual temperature is 23.6oC. Average annual humidity is 79% and average annual rainfall is 1,245 mm.

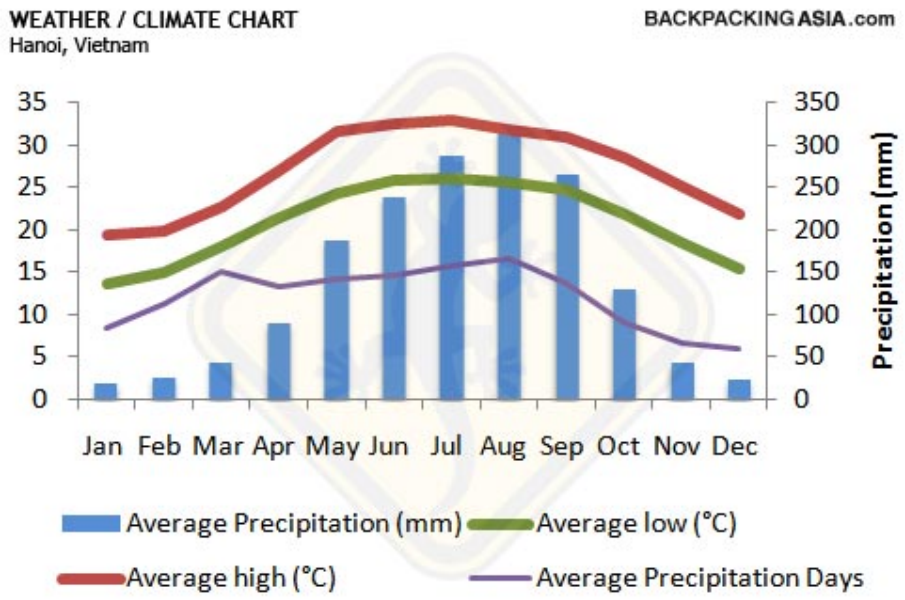



Figure 20: Climate chart of Hanoi

**- Topography:** Hanoi lies on both banks of the Red River, yet focuses heavily on the Red River's right bank. Hanoi terrain with the average height of 5-20m above sea level can be seen to slope north-to-southward and west-to-eastward. By deposited alluvium, three quarters of its natural area is plain which sits on the Da River's right bank, on both banks of the Red River and tributaries of other rivers. Its hills and mountains mostly rise in districts of Soc Son, Ba Vi, Quoc Oai, and My Duc. [Viettrade, 2011]

Most of Vietnam is situated in the tropical zone between 8 and 23 North latitude with up to 5,000 hours of sunshine per year. The average solar energy density ranges between 100 and 175 kcal/cm2/year. Generation of solar heat energy can total up to 1744.5 kWh/m2/year. The total potential is estimated at 43.9 billion TOE/year. Insulation increases from North to South: it is higher and more stable in the highlands, central coastal and southern provinces.
The table below summarizes the sun radiation intensity in five geographic areas in Vietnam with the application possibility recommended.

**Table 11: Sun radiation intensity in five geographic areas in Vietnam**

| Region | Hours of sunshine/year | Radiation kcal/cm$^2$/year | Application possibility |
|---|---|---|---|
| The Northeast | 1500-1700 | 100-125 | Low |
| The Northwest | 1750-1900 | 125-150 | Medium |
| Northern Central | 1700-2000 | 140-160 | Good |
| Central Highlands, Southern Central | 2000-2600 | 150-175 | Very good |
| The South | 2200-2500 | 130-150 | Very good |
| Average | 1700-2500 | 100-175 | Good |

[VUSTA, 2007]

In the Red River delta, including the provinces of Hanoi, Hai Phong, Ha Tay, Hai Duong, Hung Yen, Ha Nam, Nam Dinh, Thai Binh, Ninh Binh, sunshine appears most in May-October with the average radiation intensity from 3,900 - 4,100 Wh/m2/day, which ranks medium throughout the country.

The table below illustrates average daily solar radiation in Hanoi

Table 12: Daily average solar radiation statistics in Hanoi

| Month | Solar radiation (kWh/m2/day) |
|---|---|
| **January** | 2.24 |
| **February** | 2.4 |
| **March** | 2.53 |
| **April** | 3.46 |
| **May** | 5.23 |
| **June** | 5.31 |
| **July** | 5.59 |
| **August** | 5.1 |
| **September** | 4.79 |
| **October** | 4.18 |
| **November** | 3.45 |
| **December** | 2.97 |
| **Average** | **3.93** |

[Prof. Le Chi Hiep, 2007]

To sum up all the arguments, the following table 13 contains the key points of the PESTLE analysis. They are sorted in pros and cons concerning the situation of Hanoi.

Table 13: Summary of PESTLE analysis

| Summary of PESTLE analysis | | |
|---|---|---|
| | **Pros** | **Cons** |
| **Political** | • Political stability because of one-party authoritarian regime. | • Instability in long-term<br>• Corruption and bureaucracy<br>• Legal system in general still contains inconsistencies, overlapping and conflicting at several points |
| **Economical** | • Higher growth rate of Hanoi's economy, average GDP rate is 10.22% from 2006 - 2009<br>• Hanoi is projected to be one of the top cities having the world's highest average real GDP growth from 2008-2025<br>• Top provinces attracting most FDI | • High inflation<br>• High interest rate<br>• VND lost its value |

| | | |
|---|---|---|
| **Social** | • Higher living standard.<br>• Average income is 60% higher than national average.<br>• Largest education center of Vietnam<br>• 76% of population in working age | • High migration rate<br>• Different about education, living standard, etc. between the rural and urban areas |
| **Technological** | • Good infrastructure in comparison with other provinces: transport system, communication...<br>• Some good architechture areas: 79 new urban areas | • Urban architecture is not good: mostly are narrow-stress long houses. |
| **Legal** | • Many encouragements: no import duties on equipment, business premises, lower tax rate, etc<br>• Implementing the competitive retail electricity market. | • The retail electricity price of EVN is low (6 - 7 US cent/kWh), lower than the production cost<br>• Lack of guideline for some laws, i.e. Law on using energy efficiency, etc.<br>• Lack of support and encouragement for people to use RE |
| **Ecological** | • 1700 - 2000 hours of sunshine per year<br>• Sun radiation is about 3.93kWh/m2/day | • Hot, high rain fall, high humidity<br>• Not much sun light in Winter time (Jan, Feb, Mar), about ~2.5 hours/day |

### 3.1.3 SWOT analysis

After conducting the PESTLE analysis (macro analysis), the **micro environment analysis** can be done with the marketing tool - SWOT. Because many external environment impacts identified by PESTLE can be classified as the Opportunities and Threats in SWOT analysis.

In SWOT –analysis the company and/ or its products are analyzed by considering the strengths, weaknesses, opportunities and threats. The strengths and weaknesses are the analysis of the internal issues inside the company and the opportuni-

ties and threats on the other hand are the analysis of external issues. However, the study mostly focuses on analyzing Hanoi market for the small PV solar systems products. Therefore, it is necessary to combine the attributes of the technology and the market in order to find a business opportunity. This will be done in SWOT analysis, which combines the internal strengths and weaknesses of a technology with the external opportunities and threats of the market.

Table 14: SWOT analysis on solar PV systems in Hanoi

| | **Helpful to achieving the objective** | **Harmful to achieving the objective** |
|---|---|---|
| **Internal Origin attributes of the technology** | **Strengths**<br>• Long life expectancy<br>• Green, sustainable energy production: no CO2 emission, free and never ending energy resource, no noise pollution.<br>• Flexible and expandable: customers can buy separate components or whole package, can expand the capacity by install more panels, etc. | **Weaknesses**<br>• Depend on regional & climate elements<br>• High initial cost and quite a lot maintenance cost. Solar panels have long time use but other components such as battery, inverter, charge controller... have shorter life time.<br>• Need space to install panels and keep other related equipment. |
| **External Origin attributes of the target market** | **Opportunities**<br>• Increasing demand for energy<br>• Power shortage in Hanoi<br>• Personal income and living standard are growing<br>• Increase environment awareness<br>• Government promotes to increase share of renewable energy<br>• New laws, new regulations favoring RE sources, CO2 emissions control<br>• No barriers/obstacles for people to install home solar PV systems | **Threats**<br>• High threat of substitutes<br>• Low entry barriers<br>• Small solar PV systems are new in Hanoi: people's awareness not so high in comparison with some European countries.<br>• Master plan for developing RE is still in composing stage. |

### 3.1.4 Porter's 5 forces analysis

Besides, **industry structure analysis** provides the means for evaluating whether an industry is potentially profitable for the company. The best-known model is Porter's Five Forces analysis which shows that the profitability of the average firm in a particular industry depends upon 5 key factors. [Peter Doyle and Philip Stern, 2006, 115]

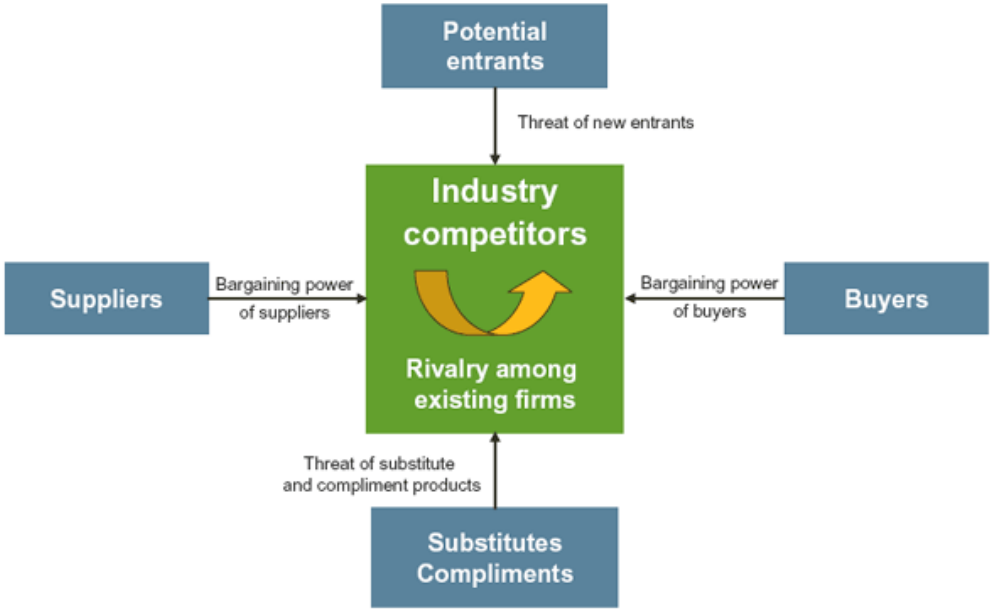



Figure 21: Porter's 5 forces analysis model

After conducting the analysis on the market, the five key forces affecting the profit of the company in the industry are illustrated below:

**Rivalry among existing firms: Low to Medium**

This industry also has a low concentration ratio because most players in this market are internal SMEs and are newcomers. At the moment, the businesses in the solar energy market in Vietnam in general and Hanoi in particular are predominantly domestic SMEs. For instance, there are some Vietnamese companies providing solar PV systems and solar hot water systems in Hanoi, such as Bach Khoa Solar company, Son Ha corporation, Tan A company, VN solar, Viet power solution, etc. and a Chinese company (China technology joint stock company). They are solar water heater manufacturers or distributors/ suppliers of some solar products or solar PV small systems for some foreign brands. Their main products are solar water heaters, solar lights, and other equipment. Tan A and Son Ha are the most famous brands because of their solar hot water heater products. Not many people know about solar PV home systems of these companies. Moreover, the

prices of their solar electric systems are much higher in comparison with other similar products providing in other country. The table below is an example of the price of solar PV systems and solar PV panels supplying by Hung Gia (Vietnamese company) and Wholesale solar:

**Table 15: Comparison of some solar equipment prices between a Vietnamese supplier and Wholesale solar**

| | Hung Gia | USD | Wholesale | USD |
|---|---|---|---|---|
| **Solar Package system*** | 3kWp | 16200 | 3,5kWp | 11700 |
| | 500 Wp | 2430 | 540Wp | 1999 |
| **Solar panel** | 220Wp | 660 | 235Wp | 380 |
| | 175Wp | 525 | 185Wp | 350 |

[Hethongtudong.vn, wholesalesolar.com, 2011]

In general, the rivalry inside the market is not really intensive. Hanoi is an open market in term of solar home PV systems, even though a huge potential is recognized.

**Threat of new entrants: Medium**

Hanoi government is welcoming the renewable energy sources and offering incentives to private companies entering the markets, such as import tax exemption, rapid depreciation allowance, support business premises, propaganda programs. The energy demand is huge and growing with higher speed than the supplying ability of EVN. It results in that the society cannot provide all needed energy and it is forced to open the regulations and possibilities for all private companies to produce and sell energy. However, there are some barriers making this market unable to boom, such as:

*"- Environmental protection consciousness of the people is not high in comparison with Europeans or people in some countries.*

*- Lack of laws/regulations that encourage the use of renewable energy.*

*- The income of most people is not high. However, Hanoi and Ho Chi Minh City may be the ideal places for selling home solar PV systems, because the awareness of people and the average income per capita are higher than other areas"*

[Quoted from the interview with Mr. Huu - National Load Dispatch Center, EVN, translated by author]

Besides, there are some Chinese companies interested in the market. *"The market really needs the pioneer, who comes fastest will lead the market. If Western companies will not come into the market quickly, Chinese companies will take the*

*pioneer advantages. After the trip in China last May, I saw that China is a potential investor in the field of renewable energy, such as wind power or solar energy"* [Mr.Thang, Manager of energy department - Hanoi Industry and Trade, translated by author]. It makes the threat of new entrants Medium.

**Strength of buyers: Medium to High**

At that moment, there is not yet much competition among the market. All the distributors are still small, that gives the buyers bargaining leverage. According to the statistics of table 3, the current main buyers of solar PV home systems are government, EVN and local governments. These customers account for 70.5% of total solar electricity installed. The households account for just 9.3% of total solar PV installed. That makes the power of buyers high, currently.

**Strength of suppliers: Low to Medium**

All the suppliers currently doing business in Hanoi are small and newcomers. Therefore, suppliers can be dependent on several customers and have to meet their idea of prices. Besides, the solar home PV systems consist of many different components, such as solar panels, charge controller, battery bank, inverter, and they all have different suppliers. Most of this equipment is available and easy to access around the world. The key issues to a competitive product are to find good quality components with the reasonable prices.

**Threat of substitute: High**

In the interviews with many experts working on the energy field, all interviewees said that the main reason that small solar PV systems are not popular in Hanoi at that moment is the high price. Buyers can easily find substitutes with lower price such as gasoline/diesel generator, batteries, UPS, small - scale wind turbines. According to the internet surveys, the most popular substitutes for home solar PV in Hanoi at the moment are gasoline - powered generators and UPS. The internet surveys show that there are about 14% households and 47.4% SMEs using gasoline-power generators and 36.6% households and 15.8% SMEs use UPS or battery as backup solutions. However, some stakeholders believe that, solar electric systems have many advantages. Therefore, if people have awareness of environment and technology, they will choose it instead of gasoline generators or UPS.

*"Many households buy small gasoline-powered generators as a back-up solution for the electricity cut off time, but from the viewpoints of environment and long-term benefits, the solar PV systems clearly have more advantages than gasoline-powered generators"* [Quoted from the interview with Mr. Huu - National Load Dispatch Center, EVN, translated by author]

*"Installing small solar PV systems for households is more reasonable in comparison with using diesel generators as backup solutions, because it is more economical and causes no environmental pollution"* [Quoted from the interview with Mr. Vu - Electricity regulatory authority of Vietnam - MOIT, translated by author]

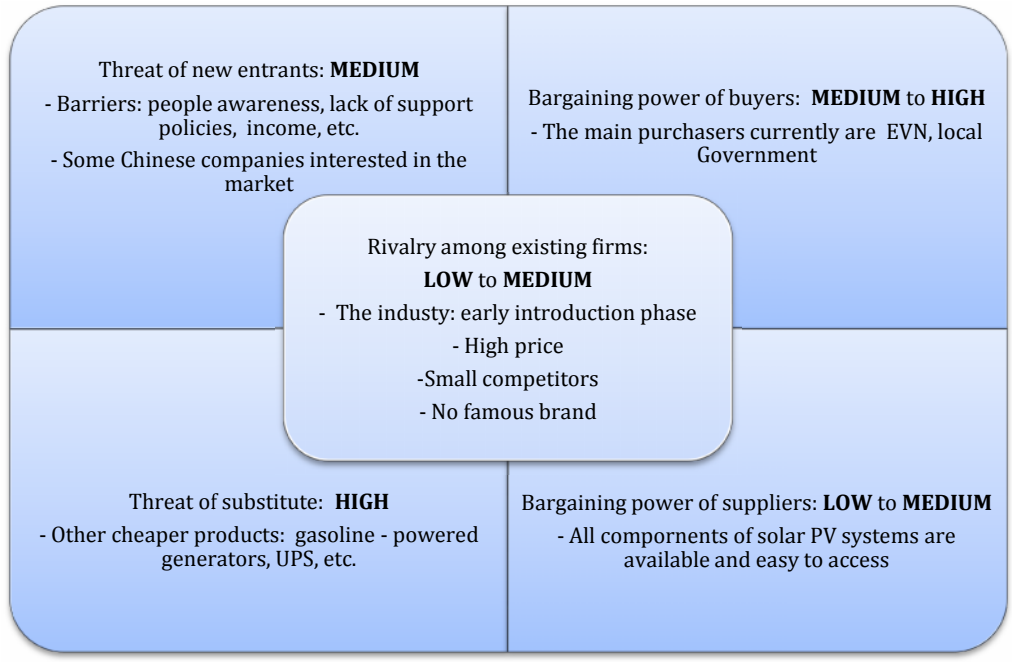



Figure 22: Porter's 5 forces analysis

To summarize, the high level of technology and high price keeps the market limited, which leads to only a few market entrances. The main difficulties for the players are the substitutes and the high rivalry through upcoming Chinese companies.

## 3.2 Market segmentation

Obviously, a firm cannot connect with all customers in large markets. Consumers vary on many dimensions and can be grouped according to one or some characteristics. A company has to identify its market segments that it can serve effectively.

Peter Doyle and Philip Stern wrote in their marketing book that a market consists of customers with similar needs, but customers in a market are never homogeneous. They differ in the benefits wanted, the amount they are able or willing to pay, the media they see and the quantities they buy. It therefore makes sense for marketers to segment and target one or more of these segments with specialized, tailored offerings. A market segment is a customer group within the market that has special characteristics which are significant for marketing strategy. In most markets, the needs for segmented offerings are obvious because a single product will not satisfy all the customers. [Peter Doyle and Philip Stern, 2006, 64]
Because the object for the market research is small solar PV systems, therefore, the main target groups in the research are households and SMEs in Hanoi.

### 3.2.1 SMEs

The SMEs can be segmented by the size, location and state of technological development and organization type. The segments were first formed by the size of the company, dividing the companies into three groups: micro, small and medium sized companies. The Article 3 of decree 56/2009 ND-CP, issued on 30/6/2009 defines the size of enterprises as follow:

Table 16: Definition of SMEs according to Decree 56/2009/ND-CP

| Field | Micro enterprise | Small enterprise | | Medium enterprise | |
|---|---|---|---|---|---|
| | Employees | Capital (VND) | Employees | Capital (VND) | Employees |
| I. Agriculture, forestry and fisheries | Less than 10 | Less than 20 billion | From 10 to 200 | From 20 billion to 100 billion | From 200 to 300 |
| II. Industry and construction | Less than 10 | Less than 20 billion | From 10 to 200 | From 20 billion to 100 billion | From 200 to 300 |
| III. Trade and services | Less than 10 | Less than 10 billion | From 10 to 50 | From 10 billion to 50 billion | From 50 to 100 |

(Note: the exchange rate on 30 July 2011: 1 USD = 20,580 VND)
The two tables below show the number of SMEs in Hanoi in consideration of criteria number of laborers and capital of enterprises as the definition above.

Table 17: Number of SMEs in Hanoi from 2000 to 2010 in consideration of criterion number of laborers

| Year | Micro company | Small company | Medium company | Large company | Total |
|---|---|---|---|---|---|
| 2000 | 2006 | 1870 | 272 | 543 | 4691 |
| 2001 | 3068 | 2478 | 271 | 590 | 6407 |
| 2002 | 4920 | 3517 | 333 | 690 | 9460 |
| 2003 | 6363 | 4316 | 396 | 738 | 11813 |
| 2004 | 8463 | 5359 | 441 | 805 | 15068 |
| 2005 | 10560 | 6337 | 521 | 796 | 18214 |
| 2006 | 14213 | 6134 | 548 | 844 | 21739 |
| 2007 | 15365 | 7915 | 661 | 882 | 24823 |
| 2008 | 24952 | 12640 | 880 | 1031 | 39503 |
| 2009* | 34481 | 16197 | 1023 | 1119 | 52819 |
| 2010* | 47649 | 20754 | 1189 | 1214 | 70805 |

Table 18: Number of SMEs in Hanoi from 2000 to 2010 in consideration of criterion enterprises' capital

| Year | Small company | Medium company | Large company | Total |
|---|---|---|---|---|
| 2000 | 3849 | 559 | 283 | 4691 |
| 2001 | 5393 | 686 | 328 | 6407 |
| 2002 | 8186 | 836 | 438 | 9460 |
| 2003 | 10336 | 978 | 499 | 11813 |
| 2004 | 13274 | 1173 | 621 | 15068 |
| 2005 | 16147 | 1365 | 702 | 18214 |
| 2006 | 19491 | 1461 | 787 | 21739 |
| 2007 | 21703 | 2061 | 1059 | 24823 |
| 2008 | 33390 | 4234 | 1879 | 39503 |
| 2009* | 43997 | 5565 | 2407 | 51969 |
| 2010* | 57975 | 7313 | 3084 | 68372 |

[cpv.gov.vn, 2010]

The figures in 2009, 2010 are estimated by the author based on the average growing rate of SMEs in the period 2000-2008. In general, the number of SMEs in Hanoi increases rapidly every year, about 38% per year with micro enterprises and more than 30% per year with small and medium enterprises. The real growth rate SMEs in Hanoi is even bigger than the calculation. According the statistic of Hanoi Planning and Investment (HAPI), by the end of June 2010 Hanoi had 100,708 registered enterprises [cpv.gov.vn, 2010].

Hanoi is always one of the two localities leading the country in number of business establishment and business registration. If considering about number of em-

ployees, 97.4 % of enterprises in Hanoi are SMEs. If examining the criterion of capital, SMEs account for 95.2% of total enterprises in Hanoi.

If using the capital criterion to divide the type of enterprises, the ratio of medium enterprises is increasing. If the number of employees is taken into consideration, the number of micro and small enterprises has grown faster than the number of medium companies. The main reason is that most enterprises in Hanoi are in the service and high technology fields using less labor than other fields.

SMEs in Hanoi can also be divided into two main groups - enterprises and household businesses. Household businesses are really common in Vietnam. **Hanoi has clear orientation for household businesses to do business on trade and service field. 53.6% of SMEs are household businesses. They are doing business mainly as wholesale and retail products, restaurants and hotels. Another interesting thing is that 55% of household businesses use their own houses as business premises.** Enterprises are mostly doing business on certain sectors such as wholesale and retail (4.5%), industry (15.7%), construction (10%), science and technology activities (9%), administrative supporting activities (4.1%), media (3.1%). **The number of enterprises has to use private houses as a business premises account for 33%.** [cpv.gov.vn, 2010]

The chart below is the calculation of the author about the percentage of SMEs using different types of business premises, which is based on the figures collected in field research.

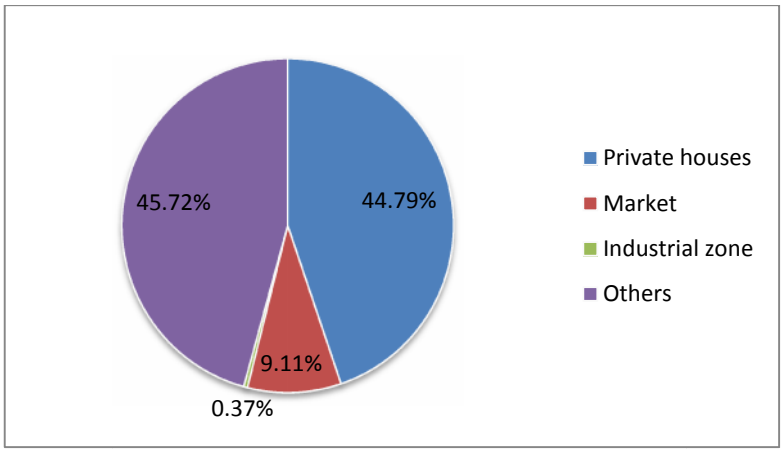



Figure 23: Different types of business premises of SMEs in Hanoi

About 44.8% of total SMEs in Hanoi use private houses as business premises. Most of enterprises using private houses as business premises are small companies.

In order to know more about this market segment, the researcher has created the internet survey for these objects, related to many aspects, such as: the situation of electricity supply in their place, the effects of electricity to their businesses, the solution they chose for the electricity cut off time, how much electricity they use each month, their opinion about solar PV, the capacity of solar PV they need, how much money they are willing to pay and what they expect from the company supplying solar PV systems. There were 19 representatives of SMEs that took part in the survey. The results of survey are shown as follow.

72% of people said that their offices suffer from electricity cut-off, and that situation affects to their businesses very much.

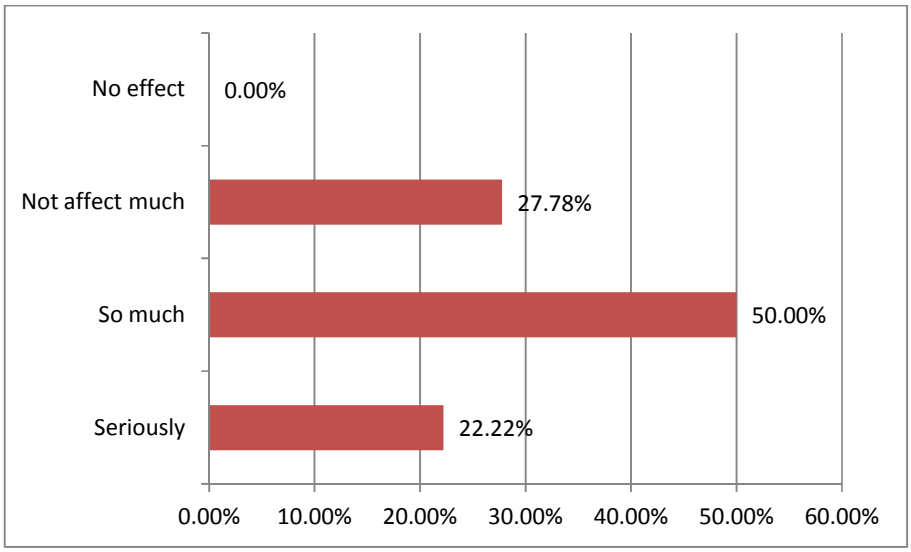



Figure 24: Effect of the electricity cut-offs to SMEs in Hanoi

About 63% of SMEs have to use gasoline-powered generators and UPS/battery as alternative solutions. Many people have heard about solar PV, 68.4% of people know that it is really good and green solution, the others think that it is very expensive. Many people know about the advantages of small solar PV systems, such as reducing the monthly payment for electricity, maintaining the company's production stability, not noisy as gasoline power generators, implementing their responsibility for environment, good PR as a green brand name. However, many people still wonder about the price of solar PV systems, the space needed to install solar PV as well as how to run the two electricity systems parallel (electricity from solar PV and national grid)

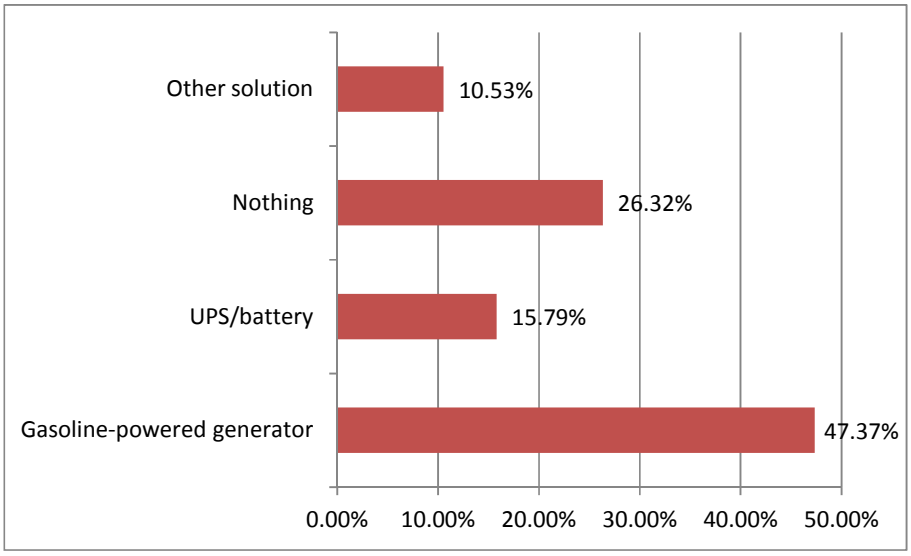



Figure 25: Alternative solutions of SMEs in electricity cut-off time in Hanoi

The internet survey also mentioned about their monthly electricity consumption. 36.8% of respondents spend less than 2%, 26.3% spend from 2% to 4%, 26.3% spend from 4% to 6% and the rest spend more than 6% of their monthly income to pay for electricity bill.

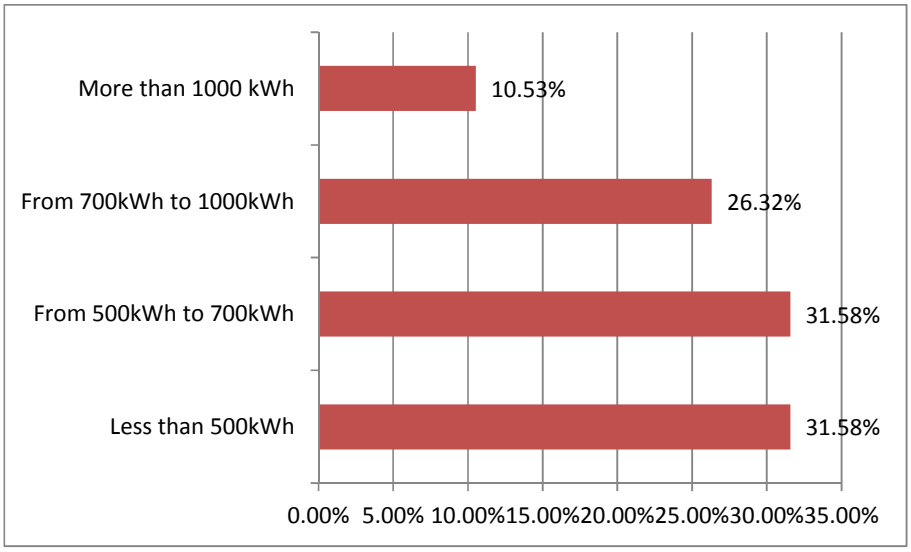



Figure 26: Monthly energy consumption of SMEs in Hanoi

When the researcher gave them some facts about Vietnamese electricity market, such as the fact the electricity price has been increasing and has floated according to market mechanisms from 1st of July 2011, and the price of petrol has increased in recent years and is estimated to increase continuously in the future, then asked them will they install a solar power system for their offices even if it requires a large initial investment, the results are as follow:

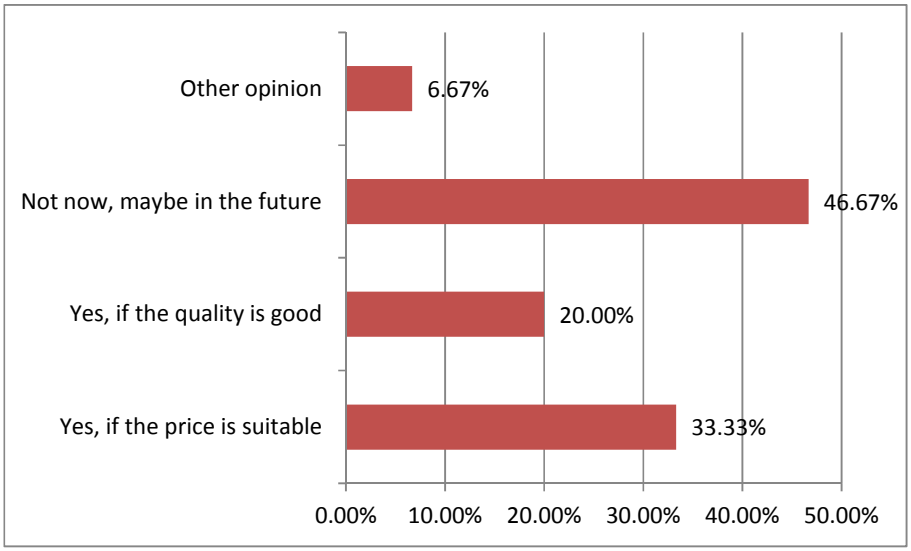



Figure 27: SMEs representatives' decisions to purchase small solar PV systems

The figure shows that there are 53.3% of respondents would buy small solar PV if the price is suitable and the quality is good. 62.5% of respondents (including representatives of SMEs and household business) are willing to pay less than 10,000USD, about 18.75% are willing to pay from 10,000 to 15,000 USD, and about 12.5% are willing to pay more than 20,000USD for the system. They also calculated their minimum capacity of solar PV systems they need, which are mostly ranged from 2kWp to 3kWp.

### 3.2.2 Households

Another internet survey was launched for the household group. The survey aims at collecting information about the situation of electricity supply in their place, the effects of electricity on their life, the solution they chose for the electricity cut off time, how much electricity they use each month, their opinion about solar PV, the capacity of solar PV they need, how much money they are willing to pay and what they expect from the company supplying solar PV systems. The target respondents are young people living in Hanoi. There are 93 people who took part in the survey.

13.2 % of respondents said that their home often and 60.4 % of respondents said that their area sometimes suffer from electricity cut-offs. The electricity cut-offs affect seriously or quite a lot to nearly 50% of respondents' families.

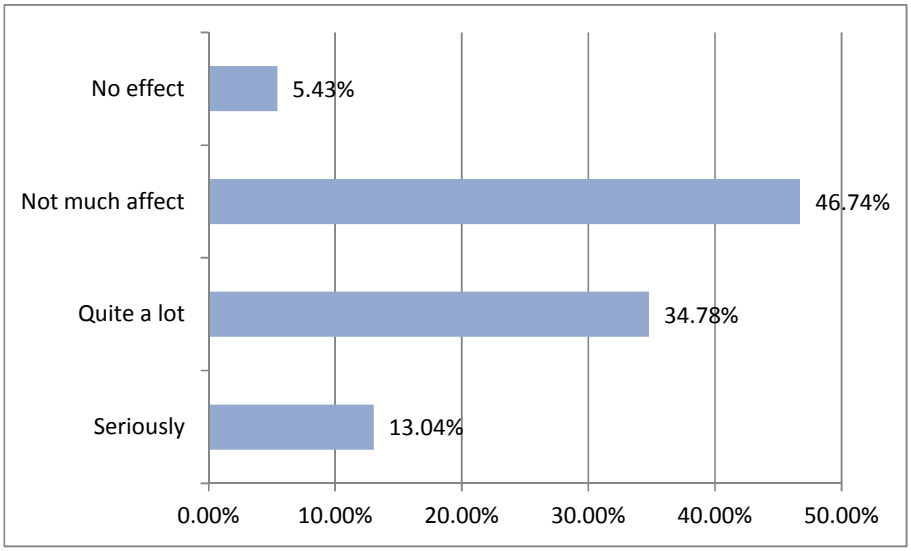



Figure 28: Effect of the electricity cut-offs to households in Hanoi

The rate of people who do not use backup systems in the electricity cut-off time account for 43%. 36.6 % of people use battery or UPS and about 14% of families use gasoline-powered generators as back-up systems.

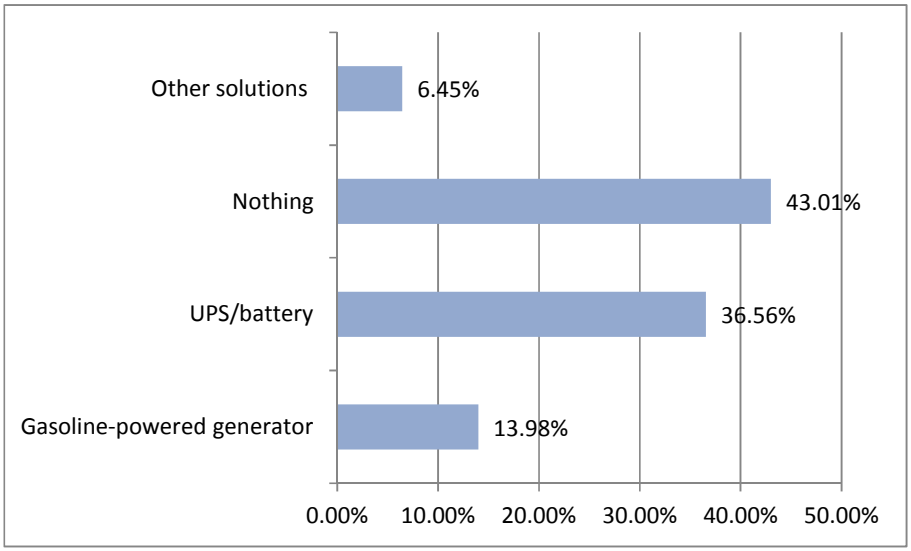



Figure 29: Alternative solutions of households for electricity cut-off time in Hanoi

The electricity consumption of people is mostly under 400kWh/month. 35.6% of respondents said that they spend less than 2% of monthly income to pay for electricity bill, 27.6% spend from 2% - 4%, 17.2% spend from 4% - 6% and 19.5% spend more than 6% of their monthly income to pay for electricity.

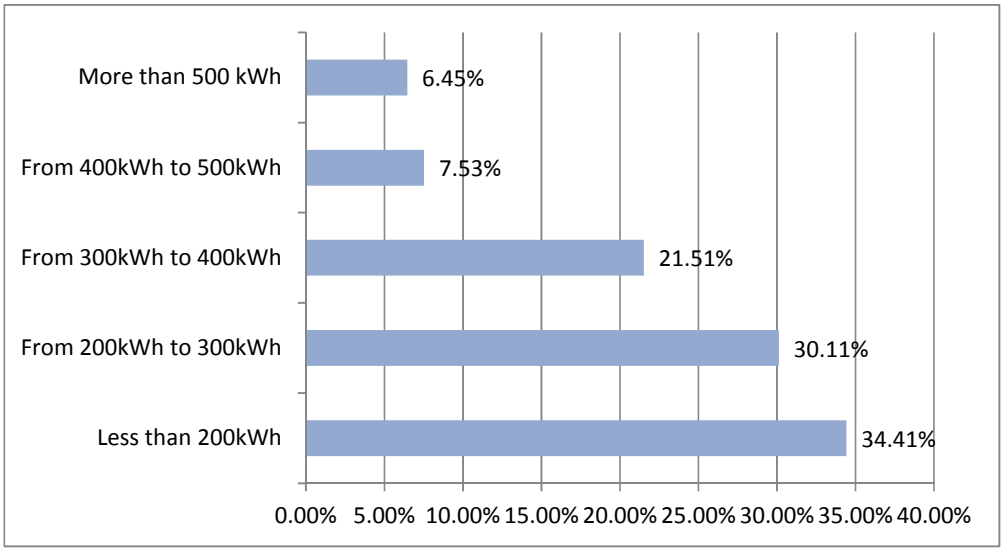



Figure 30: Electricity consumption of households in Hanoi

Most of people have heard about solar PV, and 70.6 % think it is a really good and green energy solution. There are 16.3 % of people believe that it is really expensive. A few people are afraid the sun in Hanoi is not enough to install the solar PV system.

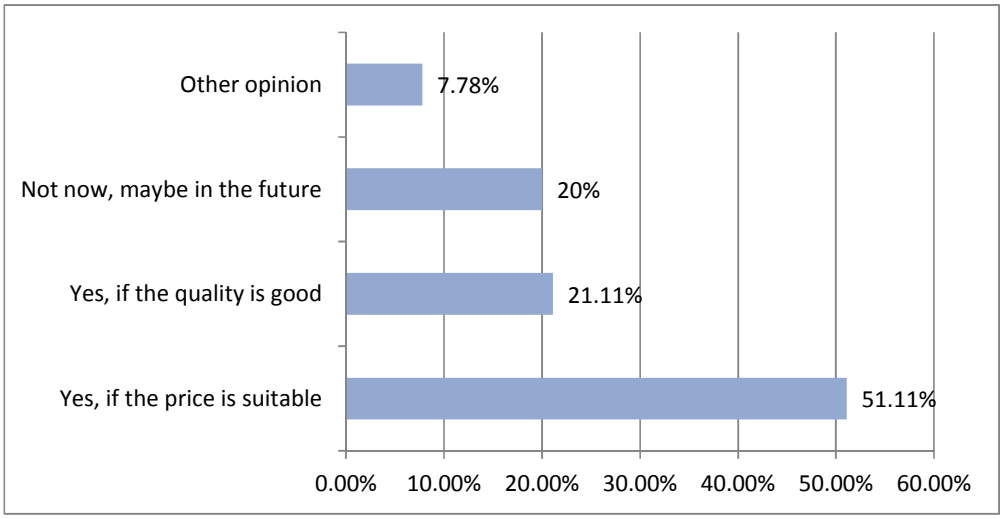



Figure 31: Hanoians' decisions to purchase small solar PV systems

51% of people said that they will install solar PV if the price is reasonable and 21% will use it if the quality is good, 20% will install it in the future. They also measure the capacity suitable for their houses, which ranged mostly from 1 kWp to 2 kWp. 82.6% of respondents are willing to pay for the system less than 5000 USD, and about 15% are willing to pay from 5000 USD to 7500 USD for the system. Most respondents want to buy products from companies providing discount, hire-purchase, and long time warranty.

The internet survey somehow demonstrates Hanoians' standpoints about solar electric home systems. However, the questions for the business are who are the most potential customer segments for the products and how to segment the household group.

Households can be divided into smaller segments, such as high-income group, medium income group, and low income group. The high-income households are seen as more potential than other groups, because these products are high price and high technical products. Most of stakeholders also shared the same opinion in the interviews with the author about the market segments for the products. *"The high income families, small offices, houses in new urban areas will be potential customers of home solar PV systems. This is because to set up a small solar PV system needs quite a lot capital to install. Besides, normally, their environmental awareness and knowledge to use the modern systems are relatively higher than other people".* [quoted from the interview with Mr.Huu, National Load Dispatch Center, EVN, translated by author].

*"The relative number of the rich in Vietnam is increasing rapidly, ranked third place in Asia, after only China and India".* It is reported by Mr. Lance Tay - Senior Director specializing in financial services of Oracle Corporation in Asia. Mr. Lance Tay also said the domestic consumers are gradually moving to use many famous brands in the world. This shows the living standards of people are improved significantly and the Vietnamese economy increases rapidly [tin247, 2010]. Reality shows that the gap between the rich people and poor people in Hanoi is high, up to 6.5 times higher in year 2010 [laodong, 2010]. According to Ministry of Labor - Invalids and Social Affairs, the income gap between the labor groups is increasing clearly, especially in big cities. In Hanoi, the difference is 42 times between the highest salary group and lowest salary group (75.2 million VND/ month and 1.8 million VND/ month). High-income group includes the executive directors, chief representatives, business people, people working in foreign enterprises, joint ventures, financial sectors, banks, securities, doctors in hospitals, etc.

There are many methods to group these people into the high-income group. But in the research, after field research, the researcher partly based the segmentation on their houses, because the product requires space in the roof to install solar panels and equipment space in the house to ensure the safety of electric system. According to the latest statistic of Ministry of Construction, the average housing area per

capita in Hanoi is really low (from 7 - 7.5 square meters per person) [thongtin-duan, 2010]. However, there are many households can buy houses or villas in new urban areas, which cost them millions of US dollars. For example, a house 275m2 in Văn Quán new urban areas, in Hà Đông district has the price 20.16 billion VND (equal to 1 million USD, or 720,000 EUR), the house 225 m2 in Xa La area (Hà Đông) costs 23.5 billion VND (equal to 1.12 million USD, or 839,286 EUR), etc [batdongsan, 2011]. Up to now, **there are 79 new urban areas in Hanoi.** The appendix 2 is the list of total new urban areas in Hanoi (including completed new urban areas and projects under construction). The table below is the names of some typical new villa areas in the center of Hanoi, the place for new rich people.

Table 19: Some typical new villa areas in Hanoi

| No | Name of new villa area |
|---|---|
| 1 | Ciputra |
| 2 | Khu Biệt thự Hồ Tây |
| 3 | Khu biệt thự Trung Hòa, Trung Yên |
| 4 | Khu biệt thự Văn Quán |
| 5 | Vạn Phúc |
| 6 | Khu Biệt thự Linh Đàm |
| 7 | Khu Biệt thự Mỹ Đình |
| 9 | Khu Biệt thự Pháp Vân |
| 10 | Khu Biệt thự Việt Hưng |
| 11 | Khu Biệt thự Tây Hồ |

Besides, there are many areas for many rich people in Hanoi, such as in Xuân Diệu road, Âu Cơ, Nghi Tàm, Vạn Bảo, etc. The suppliers also should focus on many large houses along the main roads, where houses are used as shops or hotels, restaurants, offices, studying centers, etc. Household business is a really popular business style in Hanoi, in which people use their house for living and doing business.

### 3.2.3 Market potentials and risks

Many experts working in the energy field believe that supplying solar home PV systems is a feasible business opportunity in Hanoi. After analyzing and segmenting the market, there is much potential realized.

- Size of these target segments is quite large. The characteristics of SMEs in Hanoi are household business and using private houses as business premises.

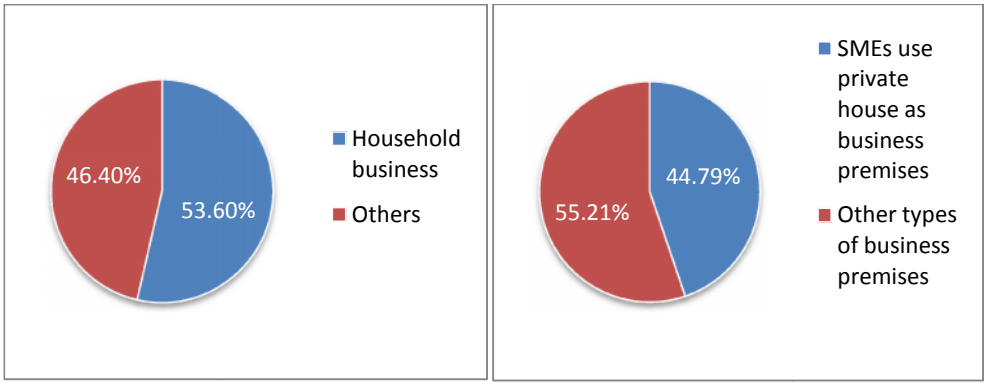



**Figure 32: Percentage of household business and percentage of private houses used as business premises in Hanoi**

The market can be segmented into 3 groups: high-income households, SMEs and mixed group (household business). However, in general, the household business group belongs to SMEs group because of similar demand for the product.

Hanoi has clear orientation for household businesses to do business on trade and service field. About 53.6% of SMEs in Hanoi are household businesses, and 44.8% of total SMEs are using private houses as business premises (55% of households and 33% of other SMEs are using private houses as business premises). It means that there are many potential customers for the small PV systems in the market. If the price is suitable and quality is good enough, there will be many customers willing to buy. The solar PV suppliers can focus on the household business group first and then expand to the high income households and other SMEs.

- The rate of the rich in Hanoi is increasing rapidly. Currently, Hanoi has 79 new urban areas and many villa areas - the places for rich people - which have good architecture.
- The number of new SMEs increases significantly every year, about more than 30% per year. The statistic shows that 95.2% of total enterprises in Hanoi are SMEs.

- There are many incentives from Vietnam government in general and Hanoi government in particular.
- Hanoi is an open market in term of solar home electric system. Because of that, this time is the right time to come into the market. If Western companies will not come to the market fast, the Chinese companies will come and lead the market as well as take pioneer advantages.

However, there are many risks in the market.

- The administrative procedure in Hanoi is quite difficult, the corruption is still widespread.
- Environmental protection consciousness of the people is not high in comparison with European people.
- Lack of laws that encourage the use of renewable energy. EVN has been doing some programs which encourage people to use compact lamps, solar water heaters. But still there is not any encouragement for people to use solar electricity. Therefore, any company who wants to sell this equipment in Vietnam, it should lobby for support policy from Government (or EVN).
- The price of solar home PV system is still high for many people.

## 3.3 Recommended business model

The business model has the target to describe how the business works. It also shows how you earn money and who are involved. Before recommending business model, the Product Service System (PSS) will be presented as a business object of the model.

### 3.3.1 Product service system (PSS)

The PSS is a sustainable approach to a business which has the goal to sell the product and the service. The PSS covers four main aspects. First, there is the Product. Which products will be the best for the market? Second, there is the service. This area can cover many points like financial services for financing the product, technical services including maintenance or even upgrade services to

keep the product state of the art. In addition to these basic components, there are the infrastructure needed for the product and the network within the supply chain. The figure below describes the PSS

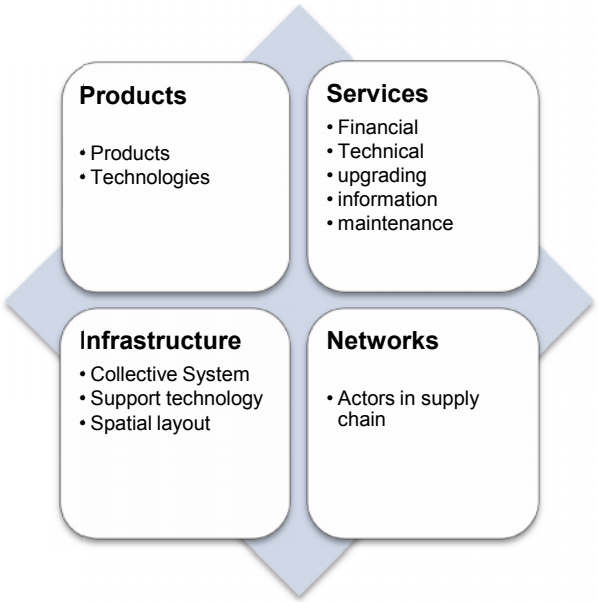



Figure 33: Product Service System Elements

[Mont 2002]

### 3.3.1.1 Product

The products in the research are home solar PV systems. The internet surveys have been done with two target groups - households and SMEs. The results of the surveys show that the suitable capacities of small PV systems are mostly ranged from 2 - 3 kWp for small offices and from 1 - 2 kWp for households.

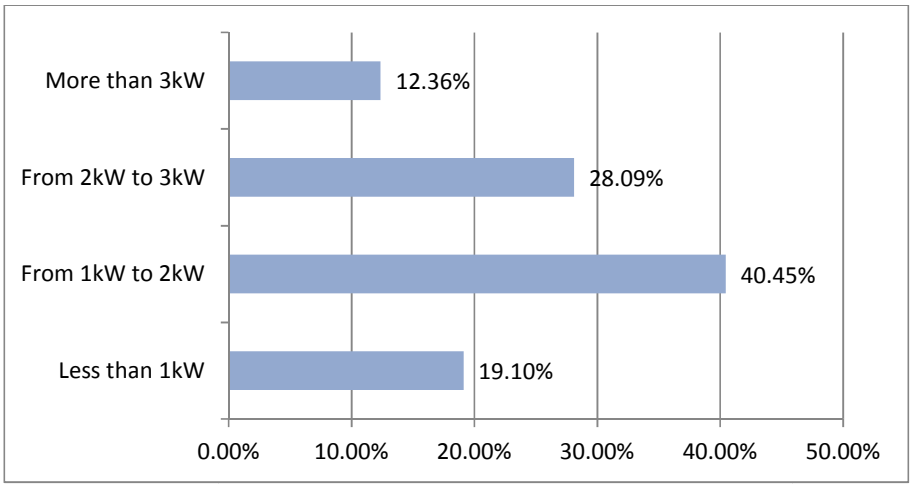



Figure 34: Minimum capacity of solar home system for households in Hanoi

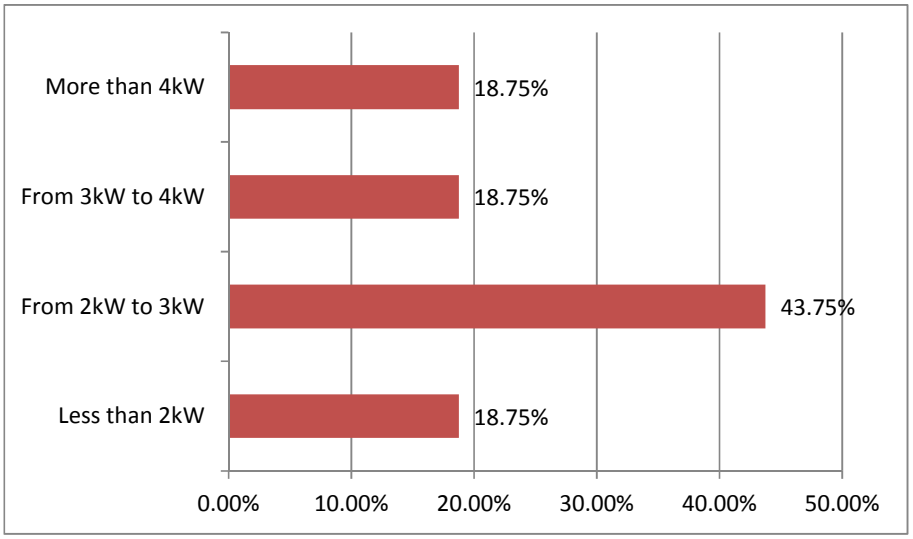



Figure 35: Minimum capacity of solar home system for SMEs in Hanoi

According to opinions of experts from face -to -face interviews with author, the best solution for the market segments is to use solar PV system parallel with electricity system from national grid. *"In my opinion, the solar PV system has many advantages. The key issue is that the households should install a solar system beside the national grid. The most effective way for them is to use the two power systems parallel"* [quoted from the interview with Mr. Thang, manager of electricity department - Hanoi Industry and Trade, translated by author]

The three most common types of solar-electric systems are grid-intertied, grid-intertied with battery backup, and off-grid (stand-alone). Each has distinct applications and component needs. However, the most suitable solar-electric system for the market is **Grid-Intertied Solar-Electric System with Battery Backup,** because without a battery bank or generator backup for grid-intertied system, when a blackout occurs, the households will be in the dark. To keep some or all electric needs (or "loads") like lights, a refrigerator, or computer running, etc. even when utility power outages occur, many homeowners choose to install a grid-intertied system with battery backup. Incorporating batteries into the system requires more components, is more expensive, and lowers the system's overall efficiency. But for many homeowners who regularly experience utility outages or have critical electrical loads, having a backup energy source is worth the investment.

The following figure illustration includes the primary components of any grid intertied solar electric system with battery backup.

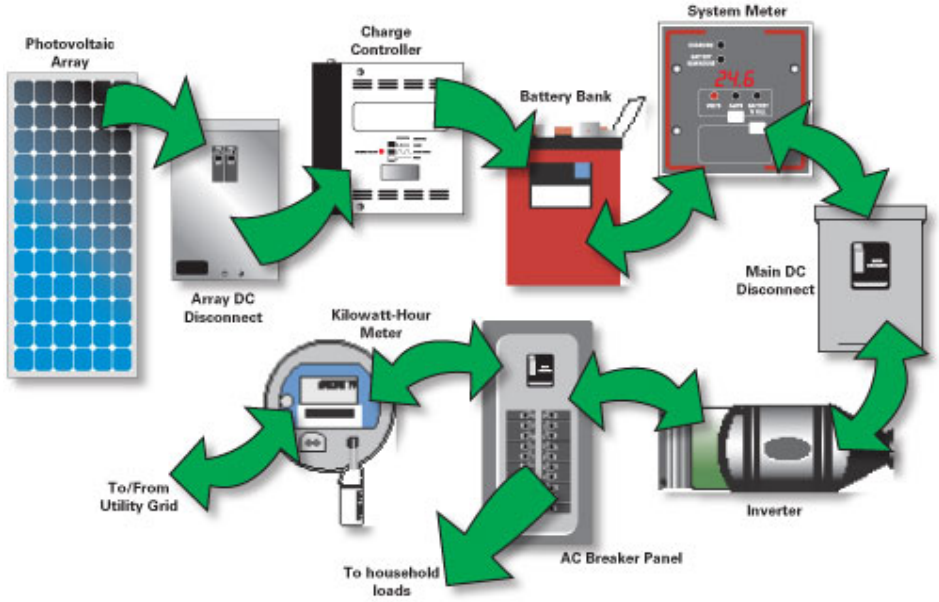



Figure 36: Grid-Intertie Solar-Electric System with Battery Backup

[homepower, 2011]

The main components of the system are solar cells, inverter, battery bank and charge controller. Besides the whole packages, the enterprise can supply a wide range of components of the solar PV systems. Because there are always have many potential customers who want to set up the solar PV for their home by themselves as well as to replace some broken components. The functions of each component will be introduced in more detail in the appendix 1.

#### 3.3.1.2 Service

The aim of any business is to deliver the service as well as the product. The service consists of selling service as well as after sale service. Selling service contains some costs such as transportation, labor cost to install the system, etc. After sale service covers some costs such as warranty service, replace some components, etc. In the life time of solar electric systems (25 - 30 years), there are some components should be changed such as battery bank, inverter, charge controller. Users of solar home systems must be able to get their equipment repaired by workshop of the company that sold these products. The cost of replacement parts and labor cost can be covered by a guarantee arrangement, a fee for service arrangement or the user has to bear all the costs or part of the costs, etc. Cost sav-

ings can be achieved when the high quality products are used. Maintenance and repair cost are substantially higher in case of low quality products.

The technique services and the fee to change some components (or operation and maintenance cost of solar PV home systems) are 100 - 110 % compared to the initial cost to install solar home PV system. The table below presents about the costs structure for 2 kWp solar PV home system. The costs are estimated by author based on price of components offered by Wholesale solar.

Table 20: Costs structure for life cycle of small solar PV systems

| Component | Initial cost (USD) | Share of initial cost (%) | Lifetime (yr) | Life-cycle cost | Share of life cycle cost (%) |
|---|---|---|---|---|---|
| Solar panel | 4000 - 6000 | 67-75% | 30 | 4000 - 6000 | 35-36% |
| Battery | 500 - 700 | 9% | 5-7 | 3000 | 18-26% |
| Charge controller | 100 - 200 | 2-3% | 5 | 600 - 1200 | 5-7% |
| Inverter | 500 - 800 | 9-10% | 5 | 3000 - 4800 | 26-29% |
| AC and DC safety disconnect | 100 - 150 | 1,9% | 5 | 600 - 900 | 5% |
| Others (meter, cable, etc.) | 70 -130 | 1,3-1,6% | 10 | 210 - 390 | 1,8-2,4% |
| Total | 5270 - 7980 | | | 11410 - 16290 | |

[wholesalesolar, 2011]

On the one hand it is logical to offer the service. On the other hand, it is a great chance for increasing revenue. However, the products should have as little downtime as possible. Reaching this requires improving the quality of the products and setting up the regular maintenance.

Besides, in order to encourage people to use more solar electric system, the company can offer financial service by selling products on hire-purchase with low interest rate.

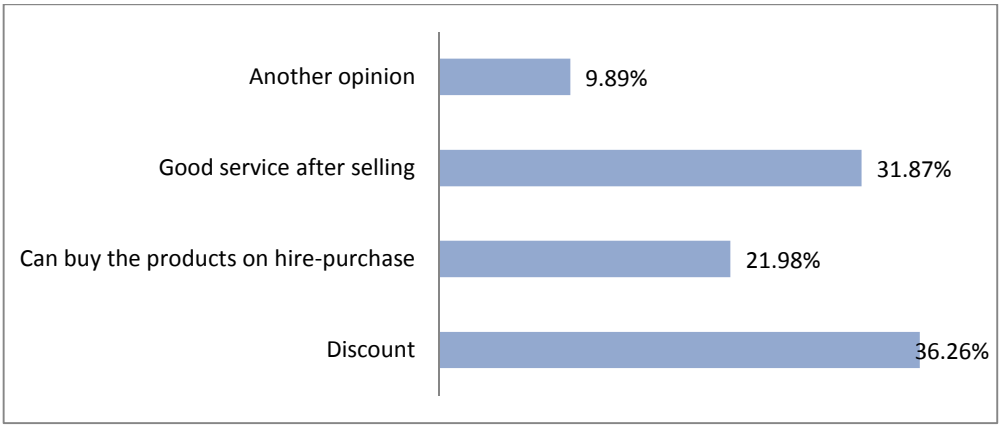



Figure 37: Expectations from the company selling solar home systems

According to the results from the internet surveys with people, there are 36.26% of people who want the company supplying solar electric systems discount on the products, 31.87% of people need good service after selling, such as long time warranty, 21.98% of people want to buy the products on hire-purchase.
The figures are different with the group of representatives of SMEs in Hanoi. The rate of respondents who want to buy the products on hire-purchase is higher than people who chose discount and good service. There are 56.3% of respondents who want to buy the products on hire-purchase, good service after selling and discount on product.

#### 3.3.1.3 Infrastructure

The first thing is about infrastructure for supplying the products. This element includes the investigation of the public infrastructure in the target market, such as public roads for example.
The second thing is the infrastructure of the place needing to install the solar electric system. The system always needs space for solar panels and one technical room to ensure the safety of the electricity system for people. Solar panels need to be orientated to receive the maximum amount of daily and seasonal sunlight. Therefore, the company should calculate about the minimum size of the roof for each solar electric system, surrounding buildings as well as the weather condition of the place. Besides, additional balance-of-system equipment will be required to transfer the generated electricity to the appliances in customer's houses or their offices. This equipment needs a safety place for storage. The whole system needs a qualified professional in order to run efficiently

#### 3.3.1.4 Network

The solar PV home system consists of many components, which can be supplied from many manufacturers world-wide. The different parts may be packed and delivered from different partner producers, assembled and installed at the site by outsourced installers. Solar PV system is a technical product and demands expertise in installation and after-sales service. The company has to build network of

transportation, services and trained experts as soon as the sales starts. Besides, these products have some specific target market segments, because of its characteristics. Therefore, the company has to build its own network with suppliers and customers, a complete supply chain.

In conclusion, the business has several aspects which need to be covered. The PSS helps to organize the coherence between the product and the service. The single elements of the business model will be explained in the next part.

### 3.3.2 Canvas model

Business model describes how an entity organizes itself to create value and derive revenue. There are many different opinions among business practitioners and academics on how to define the term business model and what elements to include. The **Business Model Canvas** is a strategic management tool, which allows enterprise to develop and sketch out new or existing business models. It is a visual template pre-formatted with the nine blocks of a business mode. In each of them an organization can draw its own ideas of a business. An overview of the model canvas template is presented in the figure below.

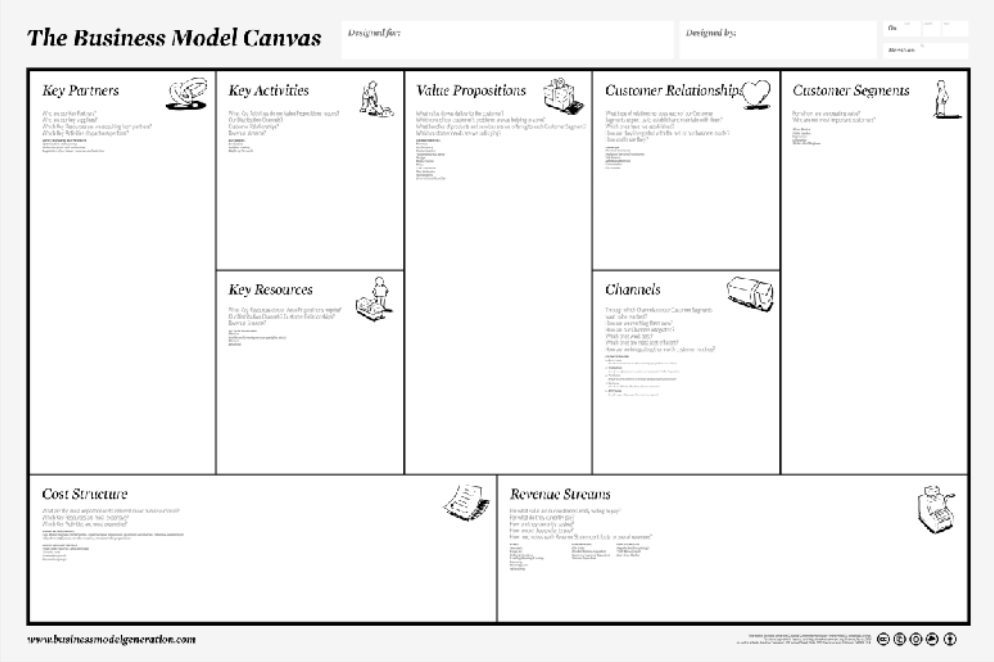



Figure 38: Business Model Canvas

[Osterwalder, 2010]

Canvas model covers nine important aspects of any business. This model can be applied for many case companies. As mentioned earlier, Hanoi is an open market in term of small solar PV system. There are many companies who can join in the market. However, in the part, the author will recommend the business model Canvas for three case companies:

(1) A Western solar module producer, who applies latest technologies.

(2) An American wholesale solar PV system, who sells many packages/ components from many producers all over the world.

(3) A Chinese solar company, who sells whole packages or components from Chinese producers with cheaper price.

How does the business model change with each case company? The market segments are defined, that leads to the products and services offered are similar with all case companies. However, each case company has different main resources, which cause each case company to need deferent key activities in the market, and key partners to co-operate in the market. It leads to the channel to supply these products and relationship with customers change as well. Each company has different channels and customer services depending on their key resources and key partners. Therefore, the revenue stream, the cost structure is affected, and the whole result of business will be different between these case companies.

#### 3.3.2.1 Canvas model for the case company 1 - A Western solar module producer

**Customer Segments**

"Who will buy products from us?" is always the first question of any business. "Customer Segments" is the first aspect of the model, and defines the different groups of people or organizations an enterprise aims to reach and serve. In the research case, the target customers of solar home electric systems are high-income households and SMEs in Hanoi. Besides, there are other segments in the market which are suitable with the products such as new urban area investors, local governments, public buildings (schools, hospitals, communications, post offices), or new segments in another provinces. Therefore, the enterprise has to answer the second question "Who are the most important customers?". For the case company, the first most important customer may be the SMEs group, especially enterprises

which use private houses as business premises. Then, the company can expand the market to other groups such as high-income households, or public buildings, etc.

**Value propositions**

This is in the middle of the model Canvas, describing the bundle of products and services that create value for a specific Customer Segments. Each segment needs different products and services. In this case, at the beginning the company offers a range of solar home PV systems (capacity from 1 kWp to 3 kWp) for the target customers - SMEs and high-income households. In addition, the goal of the business is to sell the services to customers. The services of the enterprise may be installing, financial support, upgrading, information, maintenance. Besides, the enterprise also has to supply separate components of the solar home systems for customers who need to change the broken part of their systems. This ensures a valuable amount of potential revenue. Thus, the enterprise has to design a different bundle of products and services for different segment. For example, SMEs customers need the scale ranging from 2 kWp to 3 kWp and subsidy (can buy product on hire purchase), while household customers need smaller scale and good after sale services.

**Channels**

"How/where do customers buy products from us?" is the question that has to be answered by the enterprise in this block. There are many ways to sell products to customers. In this case, the best way is directly sale or via agent network. If the enterprise wants to sell these products directly, it can build showrooms/stores and online shop in internet. If the company wants to build their own agent network, it can co-operate with a domestic company, that doing business on the field. For example, it can co-operate with Tan A or Son Ha, which have a good agent net work supplying solar hot water systems. Another responsible of these channels is not only to sell/deliver good products and services, but also to aware customers about these products. Solar electric systems are till new products in Hanoi. Many people have heard about it, but their awarenesses about the new high technology as well as environment are limited. The enterprise has to write detail information about the products in its selling website, organize some events to introduce more about the products, write many articles in newspapers or internet, build the per-

forming house in the showrooms or agents, etc. in order to raise their awareness of its products.

<table>
<tr>
<td rowspan="2">Key partners<br>- Suppliers of some components related to the solar home electric systems<br>- Local agents/ distributors<br>- Media</td>
<td>Key activities<br>- Set up distribution channel<br>- Finding other components producers<br>- Marketing and after sale services<br>- Employing local staff and training about technique or necessary skills</td>
<td rowspan="2">Value propositions<br>- Small solar PV systems (1 - 3 kWp)<br>- Components of the solar home power system<br>- Service: installing, financial, upgrading, information, maintenance.</td>
<td>Customer relationship<br>- Before sale service: information, financial, transportation, installation<br>- After sale service: customer care, guarantee service, information center, maintenance, upgrading.</td>
<td rowspan="2">Customer segments<br>- High income households<br>- SMEs<br><u>Notice:</u> households using their private houses as business premises</td>
</tr>
<tr>
<td>Key resources<br>- Good quality products<br>- Latest technologies<br>- Financial</td>
<td>Channels<br>- Direct B2B, or B2C, or B2B/C via online shop or its showrooms/ shops.<br>- Co-operate with domestic agents.</td>
</tr>
<tr>
<td colspan="3">Cost structure<br>- Distribution channel<br>- Producing module, buying other components<br>- Marketing and after sale service<br>- Employing and training</td>
<td colspan="2">Revenue streams<br>Selling new products and components<br>After sale service: upgrading, repairing, replacing.</td>
</tr>
</table>

Figure 39: Canvas model for the case company 1 - a Western solar module producer

**Customer relationship**

This block describes the types of communication the company has with its customers. “How do customers stay informed and happy?” is the question for enterprise in this block. The company can maintain relationship with customers through its marketing programs and its channels. The enterprise can divide into two groups before sale and after sale services. Before sale services may include information, financial, transportation, installation services. Before selling a product, the enterprise has always to discuss with the customer in order to create the

product they want. After selling the product it is important to keep direct contact. Therefore, the company needs well established after sale services, such as guarantee service, information center (answer customer' questions 24/7), maintenance, upgrading, customer care in special occasion (for example, send gift on customer's birthday, send greeting card in Tet holiday). Of course good services mean high cost, but it is worth to do this in order to keep the customer and even extend the market share through good word-of-mouth. And it is the best way of advertisement in Vietnam in general and Hanoi in particular.

**Revenue streams**

This block represents the cash a company generates from each Customer Segment. In this case, at the beginning, the main part of the revenue will be created through selling new products and separate components of the PV home system. The customer buys the whole package or some components and uses them for the installation in their solar electric system. The company can put the price as high as the market allows in order to make the highest possible revenue. However, in the long term, the company can have revenue from upgrading, repairing service, replacement components. A long term service contract offers possibilities to earn additional money without selling any new product.

**Key resources**

"Key resources" are the most important assets which make the business model work. The company has to know what key resources the value propositions of the enterprise require. There are many types of resources such as human resource, intellectual, financial, etc. In this case, good quality products, latest technology and finance are the key resources of the company. Besides, the enterprise has to develop other resources needed to ensure its success in the market.

**Key activities**

What key activities does the value proposition of the organization require? The "key activities" is the most important aspect of the business model. In this case, the key activities that the enterprise need to maintain their business in the market are:

- Set up distribution channel. Because, Hanoi is the new market for the case company, so it has to set up new distribution channel by itself or co-operate with domestic distributor network.
- Finding other components producers. Currently, there is no company can produce all components of the systems. That is the reason why the company has to set up a good quality supplier network to ensure providing the best products to the market.
- Marketing and after sale services. This kind of product is new in Vietnam. Therefore, the company has to build a long term marketing plan in order to raise awareness of potential customers about the products as well as supply good services.
- Employing local staff and training about technique or necessary skills

**Key partnership**

No firm can do business alone, but the question is "Who do we partner with?" Co-operating with good partners can help the company success in the market. In the case company, the main partners are:

- Suppliers of some components related to the solar home electric systems. In order to have competitive products, a global network of suppliers is required to find the best product/component or service at the best price. A strong network of suppliers supports the reliability of production.
- Local agents/distributors. If the foreign company wants to do this business in Hanoi, a good way to set up distribution is to choose a domestic partner who has a good distribution channel of similar products.
- Besides, the company also needs to co-operate with local media. It will be useful for doing PR or advertising.

**Cost structure**

The cost structure of a business reflects also the kind of actions they are doing and the strategic thinking of the business. The main costs of this case company come from the main activities and main resources:

- Building and maintaining distribution channel
- Producing module and buying other components
- Marketing and after sale service

- Employing and training local staff

Based on the business model, the case company may succeed and earn high income.

#### 3.3.2.2 Canvas model for the case company 2 - An American wholesale solar PV system

**Customer Segments**

As mentioned before, the potential customers are high-income households and SMEs in Hanoi. Besides, there are many niche market segments (such as state buildings, investors of new urban areas, government, etc). However, for the case company, at the beginning, the most important market segments are high-income households and SMEs, especially the household SMEs who use their house for doing business and living. The company should focus on these segments first, and then expand to another market segments.

**Value propositions**

The question for the company in this block is "What will be offered to target customers?" Each segment needs different products and services, therefore products and services can be customized to meet individual needs. In this case, the company offers a range of solar home PV systems (capacity from 1 kWp to 3 kWp) and separate components of the solar home electric system for the target customers. Besides, many services, such as installing, upgrading, information, maintenance, have to be provided to customers.

**Channels**

The case company is an American wholesaler, therefore the good way for them is to sell these products directly, by both internet (online trading) and traditional selling (shops/showrooms). Besides distributing the products to customers, the channel has to do many marketing activities in order to raise awareness of people about the products, and provide services to customers.

<table>
<tr>
<td rowspan="2">Key partners<br>- Local media<br>- Local university, such as HUT</td>
<td>Key activities<br>- Set up showrooms/ shops<br>- Employ local staff<br>- Set up net work of experts to install the products in the market</td>
<td rowspan="2">Value propositions<br>- Small solar PV systems (1 - 3 kWp)<br>- Components of the solar home electric system<br>- Service: installing, information, maintenance.</td>
<td>Customer relationship<br>- Before sale service: information, transportation, installation<br>- After sale service: customer care, guarantee service, information center, changing broken components</td>
<td rowspan="2">Customer segments<br>- High income households<br>- SMEs<br><u>Notice:</u> households using their private houses as business premises</td>
</tr>
<tr>
<td>Key resources<br>- Network of suppliers<br>- Good services<br>- Good at marketing</td>
<td>Channels<br>Direct channel by internet (online trading) and traditional selling way (shops/ showrooms)</td>
</tr>
<tr>
<td colspan="3">Cost structure<br>- Marketing<br>- Sale and after sale service<br>- Import products</td>
<td colspan="2">Revenue streams<br>Selling new products and components<br>After sale service: repairing, replacing.</td>
</tr>
</table>

Figure 40: Canvas model for the case company 2 - an American wholesaler

**Customer relationship**

The most important question for the company is "How to maintain relationship with customers?". Through distribution channel, the company can provide a set of services in order to create and maintain relationship with customers. The services can be divided into 2 groups:

- Before sale/selling service: information, transportation, installation.
- After sale service: customer care (for example, send greeting card or gift on special occasions in order to keep contact with customers), guarantee

service, information center (answer and help 24/7), changing broken components.

Of course, providing these services will raise higher costs, but it is worth doing this in order to keep the customer and even extend the market share through good word-of-mouth, and create chance to increase revenue when customers need to change components.

**Revenue streams**

At the beginning, revenue stream comes from selling new products and some separate components. After a few years, the services, such as upgrading, replacing new components will add to the revenue stream.

**Key resources**

This block describes the most important resources of the business needed to exist and compete in the market. In the case company, the key resources are:

- Network of suppliers. It allows the company to create a wide range of products, with different prices in order to meet each customer's demand.
- Good services. Besides, good quality products, customers always require good services. The life cycle of the product is quite long (25 - 30 years), therefore, providing good service means that it can maintain customer relationship and earn more revenue in long term.
- Good at marketing. American enterprises are always famous for marketing. Good marketing plan can help the company to access customers easily, maintain relationship with customers, expand market share.

**Key activities**

This block describes the most important actions that enterprises need to maintain their business. In other words, "key activities" is the use of resources (key resources) to create distinct values (value propositions) and thereby to gain profit (Revenue stream). In this case company, the key activities are:

- Set up its showrooms or shops to distribute the products to customers
- Marketing and after sale services.
- Employ local staff.

- Set up network of experts to install the products in the market

**Key partnership**

A good network of suppliers and partners plays the key role in the key partnership. In this case company, one of their key resources is a good network of suppliers around the world, therefore, they just need to co-operate with local media (for example, Khoa Hoc magazine, or some famous internet pages – Vnexpress, Vietnamet) in order to implement their marketing plan. Besides, the company has to co-operate with local technological university, such as Hanoi University of Technology in order to set up a network of engineers to install the solar home electric systems, or to do marketing activities (such as, use experts' standpoints in some articles, or organize conferences).

**Cost structure**

The main costs of the case company when doing business in Vietnam are:

- Import products
- Marketing
- Sale and after sale service.

The company has to calculate and put the price as high as the market allows in order to gain the higher revenue, much than the cost they pay for doing business in the market.

#### 3.3.2.3 Canvas model for the case company 3 - A Chinese solar company

**Customer Segments**

As mentioned before, the customer segments for the products are defined – high-income households and SMEs. The company has to answer the question "Which segment is the most important with the company?" before coming to the market. For the case company, the first target group they should focus on is the households which use their private houses as a business premises. After building their brand name, reducing price more and raising awareness of people about the products, they can expand the market by focusing on other market segments such as high-income households, state buildings, etc.

**Value propositions**

In this case, at the beginning, the company offers a range of solar home PV systems (capacity from 1 kWp to 3kWp) and separate components of the solar PV system and some support services (installing, guarantee, information) for target customers. They can persuade customers easier because of cheaper price.

**Channels**

In this case company, a good way for them is to co-operate with domestic agents (such as Tan A or Son Ha, etc.) to distribute the products. If it does not want to do business with domestic partners, it can create its own channel by setting up shops or showrooms and an online shop in internet. The channel is responsible to provide products, services and aware customers about the products by marketing activities.

<table>
<tr>
<td rowspan="2">Key partners<br>- Local transportation<br>- Local agents/ distributors<br>- Local media</td>
<td>Key activities<br>- Set up shops to sell products<br>- Selling promotion</td>
<td rowspan="2">Value propositions<br>- Small solar PV systems (1 - 3 kWp)<br>- Components of the solar home power system<br>- Service: installing, information.</td>
<td>Customer relationship<br>- Before sale service: information, transportation, installation.<br>- After sale: guarantee service, changing components.</td>
<td rowspan="2">Customer segments<br>- SMEs<br>- Households using their private houses as business premises</td>
</tr>
<tr>
<td>Key resources<br>- Cheaper price products<br>- Cheaper labor cost</td>
<td>Channels<br>- Co-operate with domestic agents<br>- Direct channel: Shops, Internet</td>
</tr>
<tr>
<td colspan="3">Cost structure<br>- Producing or importing products/ components.<br>- Marketing</td>
<td colspan="2">Revenue streams<br>Selling new products and components</td>
</tr>
</table>

Figure 41: Canvas model for the case company 3 - a Chinese solar company

**Customer relationship**

This block describes the types of communication the company has with its customers. The company can maintain relationship with customers by supplying services through its channel. Its advantage is cheap price, therefore they cannot provide as many services as Western companies or American companies. Their main services offering are:

- Before sale service: information, transportation, installation
- After sale service: guarantee, changing components.

**Revenue streams**

At the beginning, the main revenue comes from selling new products or components. In long term, it can offer more services and get more revenue.

**Key resources**

The key resources of the case company, which help it compete in the market are cheaper products and cheaper labor cost. Cheaper labor cost can help to reduce operation cost, cheaper products can persuade customers to buy the products easier. However, the case company should notice that, many Vietnamese customers think that "Chinese products are always cheap; and cheap price means low quality product". If the case company wants to do business in long term, it has to prove that its products have good quality and provide good after sale services.

**Key activities**

There are many activities to do, but the key activity at the beginning is to set up a distribution channel. If the company chooses to co-operate with domestic agents, it has to choose which partner and how to distribute products to customers. If the enterprise wants to set up its own channel, it has to set up showrooms or shops to sell the products as well as the online shop. The channel is not only to deliver products to customer, but also to supply sale and after sale services.

Another key activity is selling promotion, because the product is still new in the market. The activity will help the company raise the selling revenue and awareness of customers about its products.

**Key partnership**

The key partner for the case company is a local agent or distributor who is doing business in this field such as Tan A or Son Ha, if they want to co-operate with local players. Otherwise, the main partner for them is local transportation who helps to deliver products, and local media who help in marketing the products.

**Cost structure**

The case company has cheaper price products and cheaper labor cost, that helps to reduce its cost structure. However, the main costs for the company are producing or buying these products, marketing and selling products. The products are high technology products which cost quite a lot money to produce. Besides, the products are new in the market, therefore the company has to raise customers' awareness about the products. That is the reason why the cost for marketing and sale is always the main cost of the cost structure.

After the field research, the author realized that Chinese companies really want to come into the market. There is one Chinese (Chinese Technology Joint Stock Company) working in the field with wide range of products, such as solar lamps, some solar equipment, security solar systems, small solar PV systems, small wind energy systems. They have many advantages, but the main advantages are cheaper prices, cheaper labors cost, good strategy to access Vietnamese customers. However, it is still a small company and not many people know about it. If the Western company or American company will not come to the open market soon, there will be more Chinese companies come to, take pioneer advantages and lead the market.

### 3.3.3 Stakeholders analysis

The stakeholder analysis has the task to reveal the different relations between a company and its environment. Stakeholder analysis is very important to the operation of any company because the stakeholders can have a strong influence on the success or failure of its business. The question is that "who they are? How can analyze them?" Ian Alexanders has described a model proposed for requirements elicitation as a stakeholder 'onion' diagram. Based on that, a business organization can divide stakeholders into two different layers - internal and external stakehold-

ers. The first layer is the products and services being offered by the company. The second layer consists of internal stakeholders including employees, suppliers, shareholders, media, competitors, and customers. The external stakeholders, such as local people, representatives of government (MOIT, ENV, local government), NGOs, universities, etc. are in the third layer.

Of course, each case company will have different stakeholders, which have to be analyzed. However, in general, their business will be related to these stakeholders.

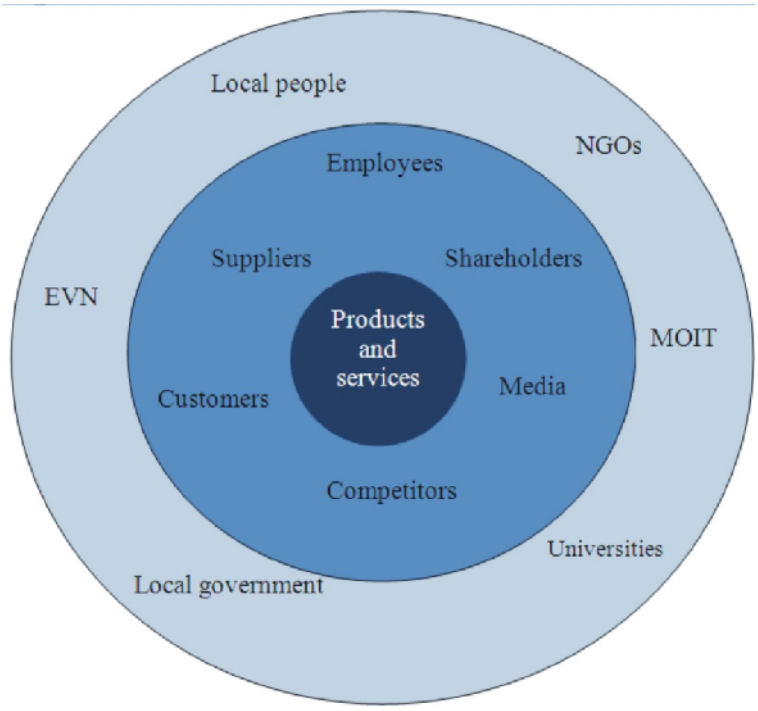



Figure 42: List of stakeholders

3.3.3.1 Internal stakeholders

- **Employees:** is a really important stakeholder, who can decide the success or failure of an organization. Especially, when doing business in Vietnam, the company has to notice more about **local staff.** For instance, for the case companies mentioned in the Canvas models before, they could employ local staff in doing sale and after sale services, or technical engineers in installing the solar energy home systems, or people in working in financial and administrative departments. Therefore, the organization has to take care of employees' demand, such as a safe and healthy working environment, fair compensation, and good salary. Employing correct staff and

keeping these staff motivated is an essential part of the strategic planning process of an organization. Training and development human resource play an important role, especially in service sector if the enterprise wants to gain a competitive edge. The stakeholder plays an important role in presenting the enterprise offering the products to customers. They take a major part in building and maintaining the customer relationship, and perform the value proposition of business.

- **Suppliers** play a key role to supply components of the complete system. There is not any enterprise which can produce all components with competitive prices. The company has to offer equipment from different suppliers in order to have the stable business and good quality products. Sustainability and responsibility are essential when building trustworthy partnerships with suppliers. Therefore, this stakeholder must be under careful monitoring. Increasing input prices will have a knock on effect on the marketing mix strategy of an organization. Prices may be forced up as a result. A closer supplier relationship is one way of ensuring competitive and quality products for an organization.
- **Shareholders & financial investors:** As sometimes, an organization requires greater investment for growth, they face increasing pressure to move from private ownership to public. Shareholders can gain access to precise and regular information about the company. To meet their expectations and enhance the quality of its dialogue with shareholders, each company should propose a series of resources for informing and trust with new investors. The company offers investors regular, accurate information and involves them in the life of business whenever possible.
- **Media:** positive media attention may help an organization increase selling quantity. However, adverse media attention on products or services of enterprise can in some cases break an organization. Media is one of the most important parts of any marketing strategy of any organization. In the field, they may be technology magazines (such as: tchdkh.org.vn, khoa-hoc.com.vn, devi-renewable.com, petrotimes.vn, etc) or some newspapers (such as: Nang luong moi) or internet web-pages (such as: vnexpress, vietnamnet, dantri, 24h) which have many readers.
- **Competitors:** the analysis on the competitors reveals both sides of the coin, because some companies are competitors on the one hand and on the

other hand are potential partners. Analyzing competitors is very important part of marketing of any company if the company wants to maintain its position within the market or gain more market share. Detail information of competitor analysis was presented in the Porter's 5 forces analysis of the study.

- **Customers** are the core of any business. Customer segments and customer relationship were mentioned earlier in the Canvas models for three case companies. However, in this part, the author just wants to confirm that the customers are always looking for complete and user-friendly solutions to solve their problems. The goal of a business is to satisfy the target customers need and create more need for customers. Therefore, in order to bring high-efficiency products, the organization always seizes the opportunities for entering into a dialogue with customers. Listening and modifying business/marketing plans are necessary so that the organization can improve the services and products provided customers.

#### 3.3.3.2 External stakeholders

- **Government:** policy makers and elected representatives have significant influence on the operating plan of any company doing business in this field. Therefore, building and maintaining close relationships (in open and transparent way) with them is important. The representatives of Government in the energy field are **Ministry of Industry and Trade** (MOIT) and **Vietnam electricity (EVN)** and for local government is **Hanoi Industry and Trade**. EVN plays a very important role in electricity market of Vietnam. The EVN is the only buyer, distributor, transmitter and regulator in energy market. Sometimes, the enterprise has to lobby for support policy in order to gain more benefit for the company and public. For example, Son Ha has lobbied for the support policy which has a subsidy of 1 million VND per household installing solar water heaters. Besides the subsidy for encouraging people using solar hot water, EVN also has the program to encourage people to use compact lamps. A representative of local government is a key external stakeholder who supports the company in legal term and also discourages the company in legal term. Environmental solutions

are put in top incentive to be invested in. But if enterprise does not have good relationship with local government, it will face the difficulty to maintain the business in that market. Otherwise, if the enterprise has good relationship with local government and EVN, they will support the enterprise quite a lot in administrative procedure, support policies, propaganda programs, or even become its customers. Government always has a budget for developing renewable energy and green solution for environment. Therefore, the company's first contacts will be local elected officials. Their comments and expectations enable the company to develop its offer intelligently. The company should put special emphasis on dialogue with local authorities, frequently facilitated by the presence of local partners.

- **NGOs:** NGOs are public pressure groups that demand more environmental protection and social engagement. The company doing business in solar PV market should plan to collaborate with NGOs (such as EEC Hanoi - Hanoi Energy Conservation Center, Devi - renewable energies) that have local presence to focus on environment issue as well as sustainable energy.
- **Universities:** There are some research institutes of solar energy in universities. Some of the research organizations are operating in the form of a company, such as Back Khoa solar from Hanoi University of Technology. They are doing research, developing technology and selling them as well. In these research institutes, there are many experts working on the field. They may create many competitive advantages for enterprise by their innovation that improves the process. They also have influences on local people's opinion.
- **Local people:** are all those surrounding the business of the company. They may be the target customers, potential customers, suppliers, or any others. They will look at any factories in their area to stop any activities which emit pollution into the environment and lower their living condition. So we have to build good reputation for good business, for example, by supporting local sustainable development projects, or organizing some environmental programs which help to raise their awareness about the solar energy.

  Besides, the company has to analysis some other stakeholders such as, local transporters, local law consultancies, and other local support service companies.

### 3.3.4 Entry mode suggestion

After all the steps, the company has to decide how to enter the market: should it develop a new business, or should it look for partners to develop alongside? When an organization has made a decision to enter an overseas market, there are a variety of options open to it. According to article 21 - Investment law 59/2005/QH11, dated on 29/11/2005, there are many forms of direct investment:

- Wholly owned subsidiaries (100% capital of foreign investors).
- Joint ventures between domestic investors and foreign investors.
- BCC, BOT, BTO, BT contracts.
- Investment in business development.
- Buying shares or contributing capital in order to participate in managing investment.
- Investment performance of a merger and acquisition.
- Other forms.

The decision of how to enter a foreign market can have a significant impact on the results. Different modes of entry may be more appropriate under different circumstances, and the mode of entry is an important factor in the success of the project. Each type of entry mode has advantages and disadvantages. Therefore, the enterprise has to choose carefully which type is the most suitable for it in Hanoi.

All the case companies have no previous business operations in Hanoi. They are still doing their business in the other markets or with other related products, and they are searching the opportunity to do business in Hanoi. There are some recommendations for the company about the entry mode to the market:

Table 21: Entry mode suggestion for 3 case companies

| Case company | Entry mode suggestion |
|---|---|
| (1) A Western solar module producer | - Joint venture with domestic producers or distributors<br>- Wholly owned subsidiary/ 100% foreign capital company (limited company type) |
| (2) An American wholesale solar PV system | - Wholly owned subsidiary/100% foreign capital company (limited company type) |
| (3) A Chinese solar company | - 100% foreign capital company (limited company type)<br>- Joint venture with domestic distributors |

In general, there are two good entry modes for the case companies. Firstly, the enterprise can co-operate with a domestic partner to set up a joint venture. It is the fastest way to come into the new market. The entry mode will help the foreign company overcome cultural distance, reduce the investment capital, and combine resources of two companies. Moreover, a local company can provide distribution network, brand name, etc. if the enterprise chooses a good reputation local firm doing business in the field (such as Tan A, Son Ha, Bach Khoa solar). Besides these advantages, there are some disadvantages of this entry mode, such as it being more difficult to manage, greater risk than export or licensing, partner may become a competitor in future.

The second suggestion for the company is to set up a wholly owned subsidiary or 100% foreign capital company (limited company type) in Hanoi. Even though it has many disadvantages, such as bearing all costs and risk, cultural distance, the entry mode is still the most popular choice of foreign investors when they do business in Vietnam. That is because of many advantages such as the enterprise can control all activities tightly, get 100% share profit.

## 3.4 Summary

The chapter presented the key findings from the field research of the author. The field study was successful and gave a good picture of the market, especially meetings with many experts working in the industry. The internet surveys also gave the

author many opinions of the local people and local representatives of SMEs. There is enormous potential and demand for electricity. The gap between the demand and the existing supply and the pressure for higher percentages of energy being produced from renewable sources are all in all increasing the demand, making sure that the solar energy such as small scale solar PV systems are welcomed to Hanoi. There are some incentives for foreign investors as well as some barriers. The chapter showed the market analysis, including many aspects, from macro analysis of the market to micro analysis of the current solar energy market in Hanoi. The high income households and SMEs were realized as being the most potential segments for the small solar PV products, even though some stakeholders suggested other market segments for the products.

The chapter also recommended the product service system (PSS), business model for three case companies - a Western solar module producer, an American solar wholesaler, and a Chinese solar company, as well as analyzed main stakeholders and suggested entry modes to the market for foreign investors.

# 4 CONCLUSION

## 4.1 Conclusions

Energy is one of the hottest issues now in Vietnam in general and Hanoi in particular. There is no doubt that the small solar PV system is a good solution for many people in both urban areas and remote areas. In Hanoi, there are many opportunities for foreign investors to supply small solar PV systems. The whole industry and the technologies are still only at an early introduction phase. There are many challenges, such as awareness of people about green energy not being as high as among European people, the price of solar PV is still high for many people, the administrative procedure in Hanoi is quite difficult, a lack of laws that encourage the use of renewable energy, etc.

Even though there are challenges, after the field study the author realized much potential in that market. Many experts working in the energy field also believe that supplying solar home PV systems is a feasible business opportunity in Hanoi.

*"As a manager in the energy field of Hanoi Government and a researcher in renewable energy industry, in my viewpoint, right this moment is the most appropriate time to come into the market. Hanoi really needs the potential investors in the solar electric home systems market. Who comes to the market first will take pioneer advantages, because Hanoi is really an open market in term of solar PV. The market really needs the pioneers. Whoever comes fastest will lead the market. If Western companies will not come into the market quickly, Chinese companies will come and take advantages of pioneer"* [Quoted from interview with Mr.Thang - manager of Energy Department - Hanoi Industry and Trade, translated by author]

The target market segments for foreign investors are high-income households and SMEs. The size of these target segments is quite large. It is a fact that the income of Vietnamese people is not high in comparison with many countries. However, the gap between the rich and the poor is quite large, and the rate of the rich in Hanoi is increasing significantly. The number of big houses and villas in new urban areas (the places for new rich people in Hanoi) is increasing rapidly. Besides, high income households, SMEs are seen as the most attractive segmentation. The number of new SMEs increases significantly every year. The statistics show that 95.2% of total enterprises in Hanoi are SMEs. Hanoi has clear orientation for household business to do business on trade and service field. An interesting thing is that people using private houses for living and doing business are really common in Hanoi. About 44.8% of total SMEs are using private houses as business premises in Hanoi. Moreover, people's awareness of environmental issues is growing because of some propaganda programs and some policies of EVN, MOIT and local government. This leads to the fact that demands for environmentally friendly technologies are growing as well.

After the field research, the author realized that the suitable product for these market segments is Grid-intertied solar-electric systems with battery backup, which have capacity ranges from 1kWp to 3kWp. The price these customer segments are willing to pay is different with each group. The survey's result for the household group showed that 82.6% of respondents are willing to pay less than 5000USD for the system, and about 15% are willing to pay from 5000USD to 7500USD for the system. The result of survey for the SMEs group illustrated that 62.5% of respondents are willing to pay less than 10,000USD, about 18.75% are willing to pay from 10,000 to 15,000 USD, and about 12.5% are willing to pay more than 20,000USD for the system.

There are many ways to come to the market, but the most suitable entry modes for the foreign company are to partner with local agents or distributors who are doing business in the similar field, or to set up a 100% foreign capital company. Each case company has its own entry mode strategy and business model, depending on its key resources and its product service systems.

In Vietnam, like in many other countries, the government is issuing development plans and incentives to encourage renewable energy production and to reduce the carbon dioxide emission. Hanoi also has some incentives to support foreign investors that want to do business in the field, such as no import duties on equipment, business premises, and propaganda programs to raise people's awareness, organizing annual exhibitions on renewable energy solutions and energy saving methods. However, if foreign enterprises want to do business in the RE industry, they should lobby for support policies.

*"EVN is financing each household 1 million VND if they buy solar water heaters from the Son Ha Company. It is because the Son Ha Company supplying the systems lobbied for this support policy. I think that if any company wants to sell this equipment in Vietnam, it should lobby for support policy"* [Quoted from the interview with Mr. Thang, Manager of Energy department - Hanoi Industry and Trade, translated by author]

*"The investors need to lobby in order to adopt encouragement and support policies early, it will be an opportunity. Now the State should go ahead, the Government has to force the public places, schools, hospitals, and other state buildings to install solar PV first. It needs the mandatory policies, for example, like other countries, if you use 100kW from national grid, you have to use at least 1kW of solar power"* [Quoted from the interview with Mr. Viet - Dean of Institute of Electricity - HUT, translated by author].

To summarize, the key findings of this study are:

- Supplying small solar PV systems in Hanoi is a feasible business opportunity. The market in Hanoi is really open and has large potential.
- The potential customers are high-income households and SMEs.
- Now is the time to come into the market. If the Western companies will not come to the market quickly, the Chinese companies will come and take the advantages of pioneers.
- The demand for small solar PV systems as back-up energy systems of SMEs and households is continuous and will become obvious. Their cur-

rent solutions now are mainly diesel generators. The needed systems are Grid-Intertied Solar-Electric Systems with Battery Backup, which have capacity range from 1- 2 kWp for households and 2 - 3kWp for SMEs.

- The price which households are willing to pay for the system is mostly less than 5000USD (82.6%), and the price which SMEs (including household business) are willing to pay is mostly less than 10,000USD (62.5%). They all require good quality products and long period of after services. Besides, many customers want to buy the products on hire-purchase.

## 4.2 Recommendations for further study

After the field study, the author realized that there are many new aspects related to the topic in Vietnam. Because of limited time, the research could not cover all of these issues.

Firstly, the researcher recognized that there are other market segments beside the high-income households and SMEs. They are schools, public places, state buildings, telecommunications, and post-offices, Government (EVN, MOIT, and local government).

*"There are many areas which still lack electricity, where solar power is the only solution. Although the prices of solar cells are expensive, the government always has funds to buy solar PV systems. The Government of Vietnam has great power, they have to achieve the objective of reducing poverty and increasing people's knowledge, so their demand for solar PV is not small. Every year, the Government spends thousands of billion VND of budget to buy solar PV systems. If the prices of solar PV are competitive, the government may become the first customer"*

[Quoted from the interview with Mr. Quang, Institute of Energy, MOIT, translated by author].

Secondly, home solar PV systems can be applied in other places, such as HCM city, and some other Southern provinces where the lack of electricity is more serious than Hanoi. The recommendation for the next potential market for these products is HCM city, which has better sun radiation, higher income per capital, and some incentives from local government.

*"Hanoi and Ho Chi Minh City may be the ideal places for selling home solar PV systems, because the awareness of people and the average income per capita are*

*higher than other areas"* [quoted from the interview with Mr.Huu, National Load Dispatch Center, EVN, translated by author]

Thirdly, besides solar PV systems, the supplier can sell other solar products. When the author interviewed some potential customers, they also were interested in some other solar products such as solar lamps, chargers, toys, etc.

All these aspects mentioned above can be good topics for further study.

**REFERENCES**


| | |
|---|---|
| [Harvey Maylor and Kate Blackmon, 2005] | Researching business and management |
| [Nick Lee and Ian Lings, 2008] | Doing business research : a guide to theory and practice |
| [Patrick Forsyth, 2006] | How to write reports & proposals |
| [Philip Kotler, Kevin Lane Keller, Swee Hoon Ang, Siew Meng Leong, Chin Tiong Tan, 2009] | Marketing management: an Asian perspective |
| [Peter Doyle, Phillip Stern, 2006] | Marketing management and strategy |
| [Kobert K.Yin, 2003] | Case Study Research: Design and method |
| [Invest in Vietnam 2010] | http://investinvietnam.vn/Default.aspx?ctl=Article&tID=2&pID=120&aID=1543 |
| [Prof. Le Chi Hiep 2009] | SOLAR ENERGY and SOLAR PHOTOVOLTAICS IN VIETNAM, Presentation in Berlin, 9.10.2009 |
| [BBC Vietnam, 2010] | http://www.bbc.co.uk/vietnamese/vietnam/2010/11/101127_vn_power_crisis.shtml |
| [Vietnamnews, 2010] | http://vietnamnews.vnagency.com.vn/Industries/201243/Solar-power-unaffordable-without-subsidy.html |
| [Frost, 2010] | http://www.frost.com/prod/servlet/market-insight-top.pag?Src=RSS&docid=159785047 |
| [EVN, 2010] | http://www.evn.com.vn/ |
| [PC2, 2010] | http://www.pc2.vn/index.php?option=com_content&view=article&id=179%3Aap-ng-nhu-cu-in-nhin-t-goc-tit-kim&Itemid=324 |
| [NPC, 2010] | http://www.npc.com.vn/npc/ |
| [Hanoi potal, 2010] | http://hanoi.gov.vn/web/guest/home?ssw75f637bc |
| [IMF, 2010] | World Economic Outlook Database-October 2010 |
| [ATP Vietnam] | http://atpvietnam.com/vn/thongtinnganh/84029/index.aspx |
| [Transparency International, 2010] | http://www.transparency.org/policy_research/surveys_indices/cpi/2010/results |
| [index of economic freedom, 2011] | http://www.heritage.org/index/country/Vietnam |
| [PricewaterhouseCooper, 2009] | http://www.pwc.com/vn/en/releases2009/press-release-en-09-11-2009.jhtml |

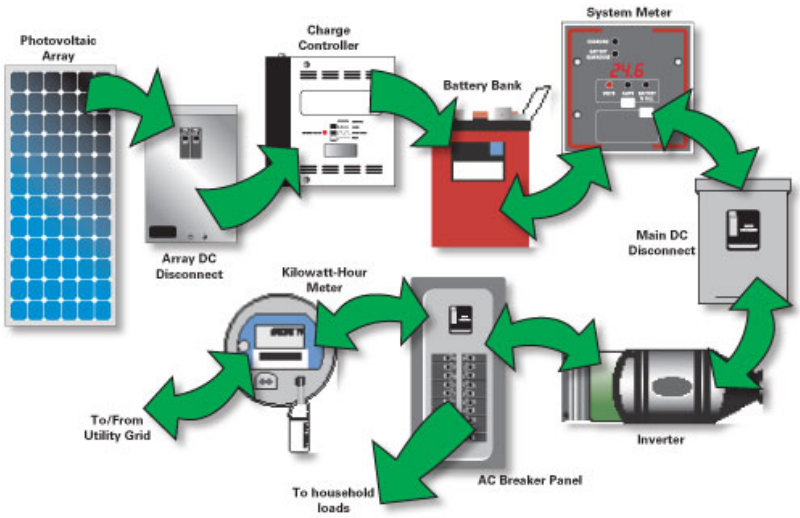
| | |
|---|---|
| [Global finance, 2011] | http://www.gfmag.com/gdp-data-country-reports/146-vietnam-gdp-country-report.html#axzz1XMhc3kfV |
| [Vietnam trade promotion agency, 2011] | http://www.vietrade.gov.vn/en/index.php?option=com_content&view=article&id=935%3Aoverview-of-ha-noi&catid=262%3Ahanoi-city&Itemid=224 |
| [quickmba, 2011] | http://www.quickmba.com/strategy/global/marketentry/ |
| [Mont, 2002] | http://www.sciencedirect.com/science/article/pii/S0959652601000397 |
| [Osterwalder, 2010] | http://www.businessmodelgeneration.com/downloads/business_model_canvas_poster.pdf Alexander Osterwalder & Yves Pignuer: Business model generation; 2010 |
| [FAO, 2011] | http://www.fao.org/docrep/W5973E/w5973e0b.htm |
| [business dictionary, 2011] | http://www.businessdictionary.com/definition/stakeholder.html |
| [Netmba, 2011] | http://www.netmba.com/marketing/market/target/ |
| [Marketingminefield, 2011] | http://www.marketingminefield.co.uk/pestle-analysis/ http://www.marketingminefield.co.uk/marketing-plan/swot-analysis.html |
| [Global trends in HRM, 2008] | http://howtomanagehumanresources.blogspot.com/2008/01/swot-analysis-strategic-planning-tool.html |
| [devi-renewable, 2011] | http://devi-renewable.com/2011/03/19/solar-pv-vietnam-overview/ |
| [The State bank of Vietnam, 2011] | http://www.sbv.gov.vn/wps/portal/!ut/p/c5/jc5LDoJAEATQs3CCqYEeB5Z8h8EPAaIiG8PCGIyAC-P5RU2MMSp2L1-qu1jFhu3qS7Ovz03f1UdWsmqyRUCOjAQhDRIBnVqFObcdiyAG37w4sikNTpbOwxVXIf5J-8qNSc4AlWQ-tEoKmzwO-QI6k17e2P77LEcfDn_8BM4K2ec7zSHihEm_-od_9_pdxwRZx3-7YqV2WaPSBXMO4AtXZ4WQ!/dl3/d3/L2dJQSEvUUt3QS9ZQnZ3LzZfMEQ0OTdGNTQwT0RKNTBJTzNTMk04OTM0MDU!/ |
| [Viettrade, 2011] | http://www.vietrade.gov.vn/en/index.php?option=com_content&view=article&id=810&Itemid=224 |
| [Thanhnien, 2011] | http://www.thanhnien.com.vn/Pages/20110401/Xay-dung-chien-luoc-phat-trien-nguon-nang-luong-tai-tao.aspx |
| [Hethongtudong.vn, wholesalesolar.com, | http://hethongtudong.vn/vn/bao-gia-mainmenu-155/bao-gia-thiet-bi-dien-nang-luong-mat-troi- |

| | |
|---|---|
| 2011] | menu.html |
| [wholesalesolar, 2011] | http://www.wholesalesolar.com/ |
| [cpv.gov.vn, 2010] | http://www.cpv.org.vn/cpv/Modules/News/NewsDetail.aspx?co_id=28340652&cn_id=427629 |
| [laodong, 2010] | http://laodong.com.vn/tin-tuc/thu-nhap-cua-nguoi-giau-va-nguoi-ngheo-chenh-toi-65-lan/25371 |
| [tin247, 2010] | http://www.tin247.com/ti_le_nguoi_giau_viet_nam_tang_nhanh_thu_3_chau_a-3-21665206.html |
| [thongtinduan, 2010] | http://www.thongtinduan.vn/index.php?option=com_content&view=article&id=2457:ha-ni-co-din-tich-nha-binh-quan-u-ngi-thp-nht-nc&catid=8:chinh-sach-phap-ly&Itemid=7 |
| [homepower, 2011] | http://homepower.com/basics/solar/#InverterComponent |
| [PCIVietnam, 2010] | http://www.pcivietnam.org/province_profile_detail.php?page=1&province=31&cboYear=2010 |
| [Hanoi.gov.vn, 2009] | http://www.hanoi.gov.vn/web/guest/diachihanoi/-/vcmsviewcontent/j5m1/1001/1001/36721 |
| [Batdongsan, 2011] | http://banbietthuxala.batdongsan.com.vn/bt6-o-05-kdt-ha-dong-ha-noi-dt-225m2-h0zdjTKEJVg1.html http://batdongsan.com.vn/ |
| [Vietnam sustainable energy sector, 2010] | http://www.revietnam.info/vietnam-sustainable-energy-sector-energy-efficiency-ee-renewable-energy-re/ |
| [VUSTA, 2007] | http://www.internationalrivers.org/files/AltPDPVietnam.pdf |
| [Duane morris Viet-nam, 2009] | www.windenergy.org.vn/uploads/101/Duane_Morris_Oli_VIE-pdf/ |
| [General Statistics Office, Vietnam 2009 Population and Housing Census] | http://news.vnu.edu.vn/ttsk/Vietnamese/C1736/C1754/C2301/2010/10/N28998/?35 http://www.gso.gov.vn/default.aspx?tabid=512&idmid=5&ItemID=10798 |
| [Xe.com, 2011] | http://www.xe.com/currencycharts/?from=USD&to=VND&view=10Y |
| [General statistic office, 2010] | http://www.gso.gov.vn/default.aspx?tabid=383&idmid=2&ItemID=10849 |
| [dvt.vn, 2011] | http://dvt.vn/20110106105532876p0c69/tang-truong-gdp-nam-2010-cua-ha-noi-dat-11.htm |

# APPENDICES

## 1. Solar power home system components

### Grid-Intertied Solar-Electric System with Battery Backup




**Solar-Electric Panels**
AKA: solar-electric modules, photovoltaic (PV) panels

PV panels are a solar-electric system's defining component, where sunlight is used to make direct current (DC) electricity. Behind a PV panel's shimmering facade, wafers of semiconductor material work their magic, using light (photons) to generate electricity—what's known as the photovoltaic effect. Other components in your system enable the electricity from your solar-electric panels to safely power your electric loads like lights, computers, and refrigerators.

PV panels are assigned a rating in watts based on the maximum power they can produce under ideal sun and temperature conditions. You can use the rated output to help determine how many panels you'll need to meet your electrical needs. Multiple modules combined together are called an array.

Although rigid panels are the most common form of solar electricity collector, PV technology also has been integrated into roofing shingles and tiles, and even peel-and-stick laminates (for metal standing-seam roofs).

PV modules are very durable and long lasting—most carry 25-year warranties.

They can withstand severe weather, including extreme heat, cold, and hail stones.

**Array DC Disconnect**
AKA: PV disconnect

The DC disconnect is used to safely interrupt the flow of electricity from the PV array. It´s an essential component when system maintenance or troubleshooting is required. The disconnect enclosure houses an electrical switch rated for use in DC circuits. It also may integrate either circuit breakers or fuses, if needed.

**Charge Controller**
AKA: controller, regulator


A charge controller's primary function is to protect your battery bank from overcharging. It does this by monitoring the battery bank. When the bank is fully charged, the controller interrupts the flow of electricity from the PV panels. Batteries are expensive and pretty particular about how they like to be treated. To maximize their life span, you'll definitely want to avoid overcharging or undercharging them.

Most modern charge controllers incorporate maximum power point tracking (MPPT), which optimizes the PV array's output, increasing the energy it produces. Some battery based charge controllers also include a low-voltage disconnect that prevents over discharging, which can perm nently damage the battery bank.

**Battery Bank**
AKA: storage battery

Your PV panels will produce electricity whenever the sun shines on them. If your system is off-grid, you'll need a battery bank—a group of batteries wired together—to store energy so you can have electricity at night or on cloudy days. For off-grid systems, battery banks are typically sized to keep household electricity running for one to three cloudy days. Gridintertied systems also can include battery banks to provide emergency backup power during blackouts—perfect for keeping critical electric loads operating until grid power is restored.

Although similar to ordinary car batteries, the batteries used in solar-electric systems are specialized for the type of charging and discharging they'll need to endure. Lead-acid batteries are the most common battery used in solar-electric systems. Flooded leadacid batteries are usually the least expensive, but require adding distilled water occasionally to replenish water lost during the normal charging process. Sealed absorbent glass mat (AGM) batteries are maintenance free and designed for grid-tied systems where the batteries are typically kept at a full state of charge. Gel-cell batteries can be a good choice to use in unheated spaces due to their freeze-resistant qualities.

**System Meter**
AKA: battery monitor, amp-hour meter

System meters measure and display several different aspects of your solar-electric system's performance and status, tracking how full your battery bank is; how much electricity your solar panels are producing or have produced; and how much electricity is in use. Operating your solar-electric system without metering is like running your car without any gauges, although possible to do, it's always better to know how much fuel is in the tank.

**Main DC Disconnect**
AKA: battery/inverter disconnect

In battery-based systems, a disconnect between the batteries and inverter is required. This disconnect is typically a large, DC-rated breaker mounted in a sheet metal enclosure. This breaker allows the inverter to be quickly disconnected from the batteries for service, and protects the inverter-to-battery wiring against electrical fires.

**Inverter**

Inverters transform the DC electricity produced by your PV modules into the alternating current (AC) electricity commonly used in most homes for powering lights, appliances, and other gadgets. Grid-tied inverters synchronize the electricity they produce with the grid's utility grade AC electricity, allowing the system to feed solar-made electricity to the utility grid.

Most grid-tie inverters are designed to operate without batteries, but battery-based models also are available. Battery-based inverters for off-grid or grid-tie use often include a battery charger, which is capable of charging a battery bank from either the grid or a backup generator during cloudy weather.

Most grid-Intertied inverters can be installed outdoors (ideally, in the shade). Most off-grid inverters are not weatherproof and should be mounted indoors, close to the battery bank.

**AC Breaker Panel & Inverter AC Disconnect**
AKA: mains panel, breaker box, fuse box

The AC breaker panel is the point at which all of a home's electrical wiring meets with the provider of the electricity, whether that's the grid or a solar-electric system. This wall-mounted panel or box is usually installed in a utility room, basement, garage, or on the exterior of the building. It contains a number of labeled circuit breakers that route electricity to the various rooms throughout a house. These breakers allow electricity to be disconnected for servicing, and also protect the building's wiring against electrical fires.

Just like the electrical circuits in your home or office, an inverter's electrical output needs to be routed through an AC circuit breaker. This breaker is usually mounted inside the building's mains panel, which enables the inverter to be disconnected from either the grid or from electrical loads if servicing is necessary, and also safeguards the circuit's electrical wiring.

Additionally, utilities usually require an AC disconnect between the inverter and the grid that is for their use. These are usually located near the utility KWH meter.

**Kilowatt-Hour Meter**
AKA: KWH meter, utility meter

Most homes with a grid-tied solar-electric system will have AC electricity both coming from and going to the electric utility grid. A bidirectional KWH meter can simultaneously keep track of how much electricity flows in each of the two directions—just the information you need to monitor how much electricity you're using and how much your solar-electric system is producing. The utility company often provides Intertied-capable meters at no cost.

**Source: Homepower magazine**
http://homepower.com/basics/solar/#InverterComponent

**2. List of new urban areas in Hanoi**

| No | Name of new urban area | Address | Size |
|---|---|---|---|
| 1 | AIC Mê Linh | Tien Phong commune, Me Linh District | 94.86 ha, of which >30 hectares for villas |
| 2 | Bắc Hà | Nguyen Trai road, Ha Dong district | 29.747m2, of which 8.242m2 for houses, 4.294m2 for villas, 3.350m2 for high buildings |
| 3 | Bắc Sông Hồng | Dong Anh district | 11,562 ha |
| 4 | Cầu Bươu | Tan Trieu, Thanh Liet, Thanh Tri | 24ha |
| 5 | CEO Mê Linh | Me Linh district | 20,21ha, high buildings, 140 villas, 63 houses |
| 6 | Dầu khí Đức Giang | Duc Giang commune, Hoai Duc district | 58,05 ha |
| 7 | Diamond Park New Mê Linh | Me Linh district | 13,7ha |
| 8 | Đồng Mai | Ha Dong district | 225,04ha |
| 9 | Hà Phong | Ha Phong, Me Linh district | 41,8ha, of which 3ha for high buildings, 20,3ha for 444 villas, 278 houses |
| 10 | La Khê | La Khe ward, Ha Dong district | 101,7ha |
| 11 | Linh Đàm | Hoang Mai district | 200ha |
| 12 | Mê Linh | Me Linh and Dai Thinh commune, Me Linh district | 251ha |
| 13 | Mỹ Đình 1, 2 | My Dinh commune, Tu Liem district | 36ha |
| 14 | Nam Hồng | Dong Anh district | 305ha |
| 15 | Nghĩa Đô | Nghia Do ward, Cau Giay district | 8,2ha, 8 high buildings, 57 villas |
| 16 | Park city | Ha Dong district | 77ha |

| | | | |
|---|---|---|---|
| **17** | Phùng Khoang | Phung Khoang, Thanh Xuan district | 460.083m2 |
| **18** | CEO Quốc Oai | Sai Son, Quoc Oai district | 24,4ha |
| **19** | Mỹ Đình - Sông Đà | My Dinh and Me Tri commune, Tu Liem district | 36ha, 7 buildings, villa and house areas |
| **20** | Trung Yên | Yen Hoa ward, Cau Giay district | 37,5ha |
| **21** | Vân Canh | Van Canh commune, Hoai Duc district | 68,5ha |
| **22** | Văn Phú | Ha Dong district | 94,1ha |
| **23** | Việt Hưng | Long Bien district | 302,5ha |
| **24** | Yên Hòa | Yen Hoa and Trung Hoa ward, Cau Giay district | 39,902ha |
| **25** | An Hưng | Ha Dong district | 31,53ha |
| **26** | Bắc Quốc Lộ 32 | Tram Troi, Hoai Duc district | 382.380m2 |
| **27** | Cầu Diễn | Cau Dien commune, Tu Liem district | |
| **28** | Cổ Nhuế - Xuân Đỉnh | Tu Liem district | 24,8ha, 5 high buidings, villas and houses. |
| **29** | Đại Kim | Dai Kim ward, Hoang Mai district | 27ha |
| **30** | Đền Lừ I, II, II | Hoang Van Thu ward, Hoang Mai district | |
| **31** | Dịch vọng | Dich Vong and Yen Hoa ward, Cau Giay district | 22,5ha |
| **32** | Dương Nội | Ha Dong district | 197,3ha |
| **33** | Gia Lâm | Long Bien and Gia Lam district | 400ha |
| **34** | Kim chung - Di trạch | Kim Chung - Di trach commune, Hoai Duc district | 170,29ha |
| **35** | Mỗ Lao | Ha Dong district | 64ha, 13 high buildings, 300 villas, 12 ha for houses |
| **36** | Mễ Trì (hạ và thượng) | Me Tri commune, Tu Liem District | 13,68ha |

| | | | |
|---|---|---|---|
| **37** | Nam Đường 32 | Hoai Duc district | 46ha, 198 villas, 832 houses, 12 high buildings |
| **38** | Nam Láng Hòa Lạc | Yen Binh and Yen Trung commune | 850ha |
| **39** | Nam Thăng Long - Ciputra | Lac Long Quan road, Xuan La and Phu Thuong ward, Tay Ho district | 394,135ha, 50 high buildings, 2.500 villas |
| **40** | Tây Hồ Tây | Xuan La, Ngia Do, Xuan Dinh, Co Nhue wards, Tay Ho district | 207,66ha |
| **41** | Thạch Bàn Garden City | Long Bien district | 32 ha |
| **42** | Phoenix Garden - Đan Phượng - Hà Nội | Hoang Quoc Viet, Dan Phuong district | 45ha |
| **43** | Thượng Thanh - Long Biên - Ha Nội | Thuong Thanh ward, Long Bien district | 124ha |
| **44** | Trung Hòa - Nhân Chính | Trung Hoa and Nhan Chinh ward, Thanh Xuan district | 30ha |
| **45** | TSQ Galaxy I + II | Ha Dong district | 15,16ha |
| **46** | Vạn Phúc | Ha Dong district | |
| **47** | Vườn Cam Vinapol | Van Canh and Lai Yen commune, Hoai Duc district | 46,18ha |
| **48** | Nam An Khánh | An Khanh commune, Hoai Duc district | 288,8ha |
| **49** | C2 Gamuda Garden | Yen So ward, Hoang Mai district | 84,272ha |
| **50** | Cầu Giấy | Quan Hoa, Dich Vong, Yen Hoa, Trung Hoa wards, Cau Giay district, My Dinh and Me Tri communes, Tu Liem district | 287,8ha |
| **51** | Làng Cổ Việt - La Phù - Hoài Đức - HN | La Phu commune, Hoai Duc district | 56ha |
| **52** | Định Công | Hoang Mai district | 35ha |
| **53** | Hoàng Quốc Việt - CIENCO 5 | Tan Lap commune, Dan Phuong district | 10,77ha |

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|---|---|---|---|
| **54** | Lê Trọng Tấn - Gelex-imco | Le Trong Tan road, Hoai Duc & Ha Dong districts | 135ha |
| **55** | Minh Giang - Đầm Và | Tien Phong commune, Me Linh District | 28,9ha, 82 houses, 226 villas |
| **56** | Nam vành Đai 3 | Thanh Tri and Hoang Mai districts | 89,749ha |
| **57** | Nam Trung Yên | Pham Hung road, Cau Giay district | 56,4ha |
| **58** | Splendora - Bắc Anh Khánh | Along Lang - Hoa Lac high way, An Khanh, Lai Yen, Song Phuong, Van Canh communes, Hoai Duc district | 264,475ha |
| **59** | Hạ Đình - Tân Triều | Tan Trieu commune, Thanh Tri district | 40.337m2, 40% area for villas |
| **60** | Tây Mỗ - Đại Mỗ | Tu Liem district | 281,02ha |
| **61** | Thanh Hà - CIENCO 5 | Phu Luong commune, Ha Dong district; Cu Khe commune, Thanh Oai district | 570.73ha |
| **62** | Thịnh Liệt | Thinh Liet, Tuong Mai, Hoang Van Thu wards, Hoang Mai district | 35,16ha, of which 6,15ha for villas |
| **63** | Tiền Phong - Mê Linh - Hà nội | Tien Phong commune, Me Linh District | 156.683m2, of which 58.276m2 for villas |
| **64** | Tứ Hiệp | Tu Hiep commune, Thanh Tri district | 16,761ha |
| **65** | Văn Khê | Ha Dong district | 23,9ha |
| **66** | Văn Quán | Van Mo, Phuc La wards, Ha Dong district | 62ha, 1.217 houses, 19 villas, 10 high-buildings |
| **67** | Xa La | National road 70, Tan Trieu commune, Ha Dong district | 209.480m2, 6 high-buildings, 700 villas |
| **68** | Ba Đình | Tien Phong, Trang Viet communes, Me Linh District | 17,1ha |
| **69** | Đặng Xá - Gia Lâm - HN | Dang Xa commune, Gia lam district | 33,6ha |
| **70** | Quang Minh | Quang Minh town, Me Linh district | 45ha for villas |

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|---|---|---|---|
| **71** | Sài Đồng | Viet Hung & Gia Thuy communes, Sai Dong town, Long Bien district | 4,583ha |
| **72** | Tây Quốc Oai | Quoc Oai district | 52,5ha |
| **73** | Trung Văn | Tu Liem district | 15,6ha |
| **74** | Văn La - Văn khê | Van Khe commune, Ha Dong district | 12,0133ha, of which 27.270m2 for high buildings, 16.395m2 for villas, 1850m2 for houses |
| **75** | Vibex Từ Liêm | Thuy Phuong and Dong Ngac commune, Tu Liem district | 25,899 ha |
| **76** | Xuân Phương | Xuan Phuong commune, Tu Liem district | 162,6ha |
| **77** | Nam An Khánh - Sudi-co | Hoai Duc district | 344,1ha |
| **78** | KĐT Việt Hưng | Duc Giang, Viet Hung, Thuong Thanh and Giang Bien communes, Long Bien district | 302,5ha |
| **79** | KĐT Pháp Vân | Tu Hiep commune, Hoang Mai district | 50,3882ha |

[Collected by author]

**3. Legal framework for investing renewable energy in Vietnam**

| | |
|---|---|
| **Legal documents on investment and operation** | - Investment Law (59/2005/QH, Comment Investment Law) dated 29 November 2005<br>- Decree No.108/2066/ND-CP dated 22/09/2006 providing details on implementation of the Investment Law<br>- Decree No.101/2006/ND-CP dated 21/09/2006 on re-registering investment certificates of foreign-invested enterprises<br>- Commercial Law (36/*2005*/QH) dated 14 June 2005<br>- Decree No. 23/2007/ND-CP dated 12/02/2007, detailing the Commercial Law regarding goods' purchase and sales' activities or goods' purchase and sales'-related activities of foreign-invested enterprises in Vietnam<br>- Enterprise Law (60/2005/QH) dated 29 November 2005<br>- Circular No.09/2007/TT-BTM guiding implementation of Decree 23/2007/ND-CP stipulating details of the Enterprise Law regarding goods' trading and activities directly relating to goods' trading of foreign-invested enterprises<br>- Circular No.05/2008/2008/TT-BCT dated 14/4/2008 of the Ministry of Industry and Trade on modification, supplementation of Circular No.09/2007/TT-BTM |
| **RE laws and regulations** | - Electricity Law 28/2004/QH dated 3rd December 2004. This law provides regulations on planning and developing electricity; saving electricity; power market; the rights and obligations of organizations and individuals engaged in electricity activities and use of electrical power protection equipment, electricity works and electrical safety.<br>- The Law on Energy Saving and Efficiency was adopted in the National Assembly on 17 June 2010. This law provides many incentives for energy efficiency and conservation as well as cleaner production measures<br>- Decree No. 21/2011/NĐ-CP dated 29 March 2011 of the Government providing detail regulations and methods to implement the Law on Energy Saving and Efficiency.<br>- The Law on Environmental Protection 2005, effective since 2006, including compulsory stra- |

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| | tegic environmental assessment (SEA) tool.<br>- Decision No. 26/2006/QD-TTg dated January 26, 2006 of the Prime Minister approving the roadmap and conditions for formation and development of different levels of the electricity market in Vietnam<br>- Decision No. 130/2007/QD-TTg dated August 02, 2007 of the Prime Minister on several financial mechanism and policies applied to investment projects on clean development mechanism<br>- The National Energy Development Strategy of Vietnam, approved on 27 December 2007 giving priority to development of renewable energy.<br>- Decision No. 110/2007/QD-TTg approving the planning on national electricity development in the 2006-2015 period, with a vision to 2025 taken into consideration<br>- Decree No. 105/2005/ND-CP dated August 17, 2005 of the Government on the establishment and operation of representative offices of foreign cooperation and research organizations in Vietnam<br>- The new environmental tax measures, Ministry of Finance, promoting energy efficiency and renewable energy indirectly by putting taxes on oil, gas and coal and specific pollutants.<br>- The National Target Program in Response to Climate Change, including incentives for emissions reduction and low carbon economic development, 2008.<br>- The Action Plan in response to climate change of the Ministry of Industry and Trade (MoIT), September 2010. |

[Collected by author]

## 4. Internet survey reports

Survey for household group

| | Question | Responses | Percent |
|---|---|---|---|
| 2 | **Do you often suffer from electricity cut-offs?** | | |
| | Often | 12 | 13.19% |
| | Sometimes | 55 | 60.44% |
| | Rarely | 24 | 26.37% |
| | Never | 0 | 0% |
| 3 | **How do the electricity cut-offs affect to your family/business?** | | |
| | Seriously | 12 | 13.04% |
| | Quite a lot | 32 | 34.78% |
| | Not much affect | 43 | 46.74% |
| | No effect | 5 | 5.43% |
| 4 | **What is your current alternative solution applied in your family when the power is cut off?** | | |
| | Gasoline-powered generator | 13 | 13.98% |
| | UPS/battery | 34 | 36.56% |
| | Nothing | 40 | 43.01% |
| | Other solutions | 6 | 6.45% |
| 5 | **How much is your family's monthly energy consumption?** | | |
| | Less than 200kWh | 32 | 34.41% |
| | From 200kWh to 300kWh | 28 | 30.11% |
| | From 300kWh to 400kWh | 20 | 21.51% |
| | From 400kWh to 500kWh | 7 | 7.53% |
| | More than 500 kWh | 6 | 6.45% |
| 6 | **Could you tell me what percent (%) of your family income is used for monthly energy consumption?** | | |
| | Less than 2% | 31 | 35.63% |
| | From 2% to 4% | 24 | 27.59% |
| | From 4% to 6% | 15 | 17.24% |
| | More than 6% | 17 | 19.54% |
| 7 | **Have you ever heard about solar photovoltaic home systems? What do you think about the solar energy system?** | | |
| | Very expensive | 15 | 16.30% |
| | A green energy solution | 65 | 70.65% |
| | I've never heard about that | 6 | 6.52% |

| | | | |
|---|---|---|---|
| | Other opinion, please specify: | 6 | 6.52% |
| 8 | **The electricity price has been increasing and will be floated according to market mechanisms from 1st of June 2011. The price of petrol has increased in recent years and estimated to increase continuously in the future. Will you choose to install a solar power system for your family even if it requires a large initial investment but the price is stable in 20-30 years?** | | |
| | Yes, if the price is suitable | 46 | 51.11% |
| | Yes, if the quality is good | 19 | 21.11% |
| | Not now, maybe in the future | 18 | 20% |
| | Other opinion, please specify: | 7 | 7.78% |
| 9 | **How much is the minimum capacity of the alternative power generator you need to run the basic electrical equipment in your family?** | | |
| | Note: With the 1kW system, your family can run the basic electrical equipment such as lights (80W), refrigerator (120W), 40 inch television (160W), computer (200W), fan (50W), washing machine (210W). With the higher capacity, you can use more equipment which consume high power such as air condition (1000W), micro wave (1000W), etc. | | |
| | Less than 1kW | 17 | 19.10% |
| | From 1kW to 2kW | 36 | 40.45% |
| | From 2kW to 3kW | 25 | 28.09% |
| | More than 3kW | 11 | 12.36% |
| 10 | **How much are you willing to pay for installing a solar power system for your family? (Please notice that the average lifespan of a solar power system is about 20 - 30 years, and the average price currently offered on the market is about 5 USD/Wp)** | | |
| | Less than 5000 USD | 71 | 82.56% |
| | From 5000 USD to 7500 USD | 13 | 15.12% |
| | From 7500 USD to 10000 USD | 1 | 1.16% |
| | More than 10000 USD | 1 | 1.16% |
| 11 | **What do you expect most from the companies supplying the solar PV home systems?** | | |
| | Discount | 33 | 36.26% |
| | Can buy the products on hire-purchase | 20 | 21.98% |
| | Good service after selling | 29 | 31.87% |
| | Other opinion, please specify: | 9 | 9.89% |

Survey for SMEs group

| | Question | Responses | Percent |
|---|---|---|---|
| 2 | **Does your office suffer from electricity cut-offs?** | | |
| | Often | 1 | 5.26% |
| | Sometimes | 11 | 57.89% |
| | Rarely | 7 | 36.84% |
| | Never | 0 | 0.00% |
| 3 | **How do the electricity cut-offs affect to your business?** | | |
| | Seriously | 4 | 22.22% |
| | So much | 9 | 50.00% |
| | Not affect much | 5 | 27.78% |
| | No effect | 0 | 0.00% |
| 4 | **What is your current alternative solution applied in your office when the power is cut off?** | | |
| | Gasoline-powered generator | 9 | 47.37% |
| | UPS/battery | 3 | 15.79% |
| | Nothing | 5 | 26.32% |
| | Other solution | 2 | 10.53% |
| 5 | **How much is your company's monthly energy consumption?** | | |
| | Less than 500kWh | 6 | 31.58% |
| | From 500kWh to 700kWh | 6 | 31.58% |
| | From 700kWh to 1000kWh | 5 | 26.32% |
| | More than 1000 kWh | 2 | 10.53% |
| 6 | **Could you tell me what percent (%) of your company revenue per month is used for energy consumption?** | | |
| | Less than 2% | 7 | 36.84% |
| | From 2% to 4% | 5 | 26.32% |
| | From 4% to 6% | 5 | 26.32% |
| | More than 6% | 2 | 10.53% |
| 7 | **Have you ever heard about small solar photovoltaic systems? What do you think about the solar energy system?** | | |
| | Very expensive | 6 | 31.58% |
| | An interesting and green energy solution) | 13 | 68.42% |
| | I've never heard about that | 1 | 5.26% |
| | Other opinion | 1 | 5.26% |
| Note: For this question, the respondents can choose more than 1 option. | | | |
| 8 | **In your opinion, what advantages do the small solar PV systems have?** | | |
| | Reducing the monthly payment for electricity | 6 | 31.58% |
| | Maintaining the company's production stable | 5 | 26.32% |

| | | | |
|---|---|---|---|
| | Not noisy as gasoline power generators | 6 | 31.58% |
| | Implementing our responsibility for environment | 7 | 36.84% |
| | A good way to PR about green brand name | 4 | 21.05% |
| | All advantages above | 12 | 63.16% |
| | Other opinion, please specify: | 1 | 5.26% |
| Note: For this question, the respondents can choose more than 1 option. | | | |
| **9** | **In your opinion, besides the advantages, what are disadvantages of small solar PV systems?** | | |
| | Need a large investment | 13 | 81.25% |
| | Need much space to install solar panels | 6 | 37.50% |
| | It's difficult to ensure the safety | 2 | 12.50% |
| | It's not easy to run 2 systems parallelly (solar PV system and normal electricity system from national grid | 3 | 18.75% |
| | All disadvantages above | 2 | 12.50% |
| | Other opinion, please specify: | 1 | 6.25% |
| Note: For this question, the respondents can choose more than 1 option. | | | |
| **10** | **The electricity price has been increasing and has floated according to market mechanisms from 1st of July 2011. The price of petrol has increased in recent years and estimated to increase continuously in the future. Will you choose to install a solar power system for your office even if it requires a large initial investment but the price is stable in 20-30 years?** | | |
| | Yes, if the price is suitable | 5 | 33.33% |
| | Yes, if the quality is good | 3 | 20.00% |
| | Not now, maybe in the future | 7 | 46.67% |
| | Other opinion, please specify: | 1 | 6.67% |
| Note: For this question, the respondents can choose more than 1 option. | | | |
| **11** | **How much is the minimum capacity of the alternative power generator you need to run the basic electrical equipment in your office?** | | |
| | Note: With the 2kW system, your office can run the basic electrical equipment such as 8 lights (320W), 4 computers (800W), 4 laptops (280W), 4 fan (200W), telephone system, fax machine, etc. With the higher capacity, you can use more equipment consuming high power such as air condition (1000W/unit)… | | |
| | Less than 2kW | 3 | 18.75% |
| | From 2kW to 3kW | 7 | 43.75% |
| | From 3kW to 4kW | 3 | 18.75% |
| | More than 4kW | 3 | 18.75% |
| **12** | **How much are you willing to pay for installing a solar power system for your office? (Please notice that the average lifespan of a solar power system is about 20 - 30 years, and the average price currently offered on the market is about 5 USD/Wp)** | | |
| | Less than 10,000 USD | 10 | 62.50% |
| | From 10,000 USD to 15,000 USD | 3 | 18.75% |
| | From 15,000 USD to 20,000 USD | 1 | 6.25% |
| | More than 20,000 USD | 2 | 12.50% |

| 13 | What do you expect most from the company supplying the small solar PV systems? | | |
|---|---|---|---|
| | Discount | 5 | 31.25% |
| | Can buy the products on hire-purchase | 6 | 37.50% |
| | Good service after selling | 5 | 31.25% |
| | All options above | 9 | 56.25% |
| | Other opinion, please specify: | 1 | 6.25% |
| Note: For this question, the respondents can choose more than 1 option. | | | |

**5. Summary of inteviews**

| **INTERVIEW SUMMARY** | |
|---|---|
| Name of Interviewee | **Ma. Nguyen The Huu** |
| Occupation | **Deputy manager of Administration and Human resources,**<br>**National Load Dispatch Center, Vietnam Electricity (EVN)** |
| Date of the interview | **9 June 2011** |
| Issues discussed:<br><br>1. Electricity supply in Vietnam and Hanoi.<br>2. The sustainable solutions to solve the power shortage of the government and EVN<br>3. The potential customers of the small solar PV systems and the reasons.<br>4. The laws and regulations related<br>5. The price of these systems can attract customers<br>6. The main barriers for foreign investors | |
| Some notices for foreign investors from the interview:<br><br>1. Vietnam and Hanoi still lack of electricity, about 3 billion kWh of electricity in 2011. Residential areas in Hanoi still have to suffer from power cut off in turn.<br>2. Small solar PV system is a good solution to solve the electricity cut off.<br>3. Vietnam is implementing the power market mechanism that aim to reduce the intervention of Government in energy markets.<br>4. With the gap between the supply and demand of electricity in the current period, the increase in electricity prices in Vietnam is unavoidable.<br>5. The potential customers are high income households, small office in big cities<br>6. The competitive price for small solar PV systems is about 8,5 - 9 US cents per kWh.<br>7. There are many barriers such as lack of laws or regulation to encourage the use of renewable energy, the environmental awareness of people, etc. | |

| **INTERVIEW SUMMARY** | |
|---|---|
| Name of Interviewee | **Ph.D Dinh Ngoc Quang** |
| Office | **Institute of energy - Ministry of Industrial and Trade** |
| Date of the interview | **18 June 2011** |

Issues discussed:

1. Electricity supply in Vietnam and Hanoi, and the solutions to solve the power shortage of the government and EVN
2. The small solar PV systems for households in Hanoi
3. The potential customers
4. The laws and regulations related
5. The right time for investors to join into the market.

Some notices for foreign investors from the interview:

1. Currently the demand for power increases faster than the supply of the system.
2. The main customers now are EVN, the government, The ministry of industry and trade (MOIT) and local governments. They now have to buy small solar PV systems at very high price, about 8,5USD/Wp.
3. In the future solar system will be more interested by the State. According to the national energy development strategy *(Master plan VII),* the government will increase about 5 MW of solar energy per year.
4. When the retail electricity price of Vietnam increases more, potential customers are high income households.
5. There are some laws and regulations to encourage and support: The Law on Energy Saving and Efficiency, the decree 21/2011/ND-CP, etc.
6. The suitable time to come to Hanoi is after the year 2015. Now is the time to advertise and build up company's brand name.

| **INTERVIEW SUMMARY** | |
|---|---|
| Name of Interviewee | **Mr. Dam Tien Thang** |
| Occupation | **Manager of Electricity Department - Hanoi Industry and Trade** |
| Date of the interview | **4 June 2011** |

Issues discussed:

1. The small solar PV systems as the solutions to solve the power shortage in Hanoi
2. The potential customers of the small solar PV systems in Hanoi and the reasons.
3. The incentives from Hanoi.
4. The investment procedures in the Hanoi
5. The main barriers for foreign investors in Hanoi.
6. The solutions to encourage people to use the systems

Some notices for foreign investors from the interview:

1. Hanoi is one of the pioneer provinces using renewable energy and energy saving methods.
2. Hanoi is nearly an open market in term of small solar PV systems.
3. There are many encouragements, such as no import duties, business premises, etc.
4. Hanoi is trying to find many ways to support potential investors.
5. Now is the right time for foreign investors to come into Hanoi. Who comes first will lead in the market
6. The price of retail electricity in Vietnam will be raised soon, because now it is being sold cheaper than production costs.
7. Any company wants to sell the equipment in Vietnam, it should lobby for support policy from Government (or EVN).
8. The potential customers of the small solar PV systems are high income households, new urban area constructors.

| **INTERVIEW SUMMARY** | |
|---|---|
| Name of Interviewee | **Ma. Trinh Quoc Vu** |
| Office | **Electricity regulatory authority of Vietnam - Ministry of Industry and Trade** |
| Date of the interview | **2 June 2011** |

Issues discussed:

1. The electricity supply in Vietnam and Hanoi, and the solutions to solve the power shortage problem.
2. The development of clean energy in Vietnam
3. Solar PV in Hanoi and the feasibility of supplying small solar PV in Hanoi
4. Potential customers of small solar PV systems in Hanoi
5.The price of small solar PV system can attract customers
6. Law incentives for foreign investors in this field

Some notices for foreign investors from the interview:

1. Vietnam's power system still has to face the power shortage in future.
2. The potential customers of small solar PV systems are high income households, small offices, new urban area investors.
3. It could be better if people use small solar PV system parallelly with power from national grid.
4. One of the reasons for the unpopularity of solar PV in Hanoi is there are no manufacturers or distributors to recommend solutions and analyze the effectiveness of installing the systems.

| **INTERVIEW SUMMARY** | |
|---|---|
| Name of Interviewee | **PhD Nguyen Hoang Xuan Viet** |
| Occupation | **Dean of Institute of Electricity - Hanoi University of Technology.** |
| Date of the interview | **8 June 2011** |
| Issues discussed:<br><br>1. Sun radiation in Hanoi<br>2. The solar PV systems.<br>3. The reasons why small solar PV systems have not been popular in Hanoi.<br>2. The potential customers of the small solar PV systems and the reasons.<br>5. The main barriers for foreign investors. | |
| Some notices for foreign investors from the interview:<br><br>1. Sun radiation in Hanoi is enough to install solar PV.<br>2. Investing big farm of solar PV is not feasible.<br>3. The potential customers are the Government, young people have high income, owners of public places such as schools, hospitals, state buildings, street lights, etc.<br>4. The investors need to lobby the Government or EVN for support policies. | |

*For detail information of the interviews and internet survey reports please contact the author via her email phieuly@gmail.com*